Dissertation on

"CORRELATION OF ARTERIAL BLOOD GAS ANALYSIS IN PREDICTIG OUTCOME OF ACUTE ORGANOPHOSPHOROUS COMPOUND POISONING "

Submitted in partial fulfilment for the Degree of

M.D GENERAL MEDICINE BRANCH – I

INSTITUTE OF INTERNAL MEDICINE

MADRAS MEDICAL COLLEGE

THE TAMIL NADU DR. MGR MEDICAL UNIVERSITY

CHENNAI – 600003

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CERTIFICATE

This is to certify that the dissertation entitled. **"CORRELATION OF ARTERIAL BLOOD GAS ANALYSIS IN PREDICTIG OUTCOME OF ACUTE ORGANOPHOSPHOROUS POISONING"** is a bonafide original work done by **Dr.S.MUKIL,** in partial fulfilment of the requirements for M.D. GENERAL MEDICINE BRANCH – I examination of the Tamilnadu Dr.M.G.R Medical University to be held in April 2019, under my guidance and supervision in 2017

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DECLARATION BY THE CANDIDATE

I hereby solemnly declare that the dissertation entitled **"CORRELATION OF ARTERIAL BLOOD GAS ANALYSIS IN PREDICTIG OUTCOME OF ACUTE ORGANOPHOSPHOROUS POISONING "** is done by me at Institute of Internal Medicine, Madras Medical College & Rajiv Gandhi Government General Hospital, Chennai during 2017 to 2018 under the guidance and supervision of **Prof.Dr.P.VASANTHI M.D.,** This dissertation is submitted to The Tamilnadu Dr. M.G.R Medical University, Chennai towards the partial fulfilment of requirement for the award of M.D. Degree in General Medicine (Branch I)

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ABBREVIATIONS

ABG	**-**	arterial blood gas analysis
OPC	-	organophosphorous compounds
Ach	-	acetyl choline
AchE	-	acetylcholinesterase
Ch	-	choline
ODIDP	-	organophosphate induced delayed polyneuropathy
COPIND	-	chronic organophosphate induced neuropsychiatric disorder
POP	-	Paradeniya organophosphorus poisoning
SGOT	-	serum glutamate oxaloacetate transaminase
LDH	-	lactate dehydrogenase
mg	-	milligram
IU	-	international units
dl	-	deciliter
gm	-	gram
P2AM	-	pralidoxime

CONTENTS

INTRODUCTION

INTRODUCTION

Organophosphporous compounds are world wide used pesticides which is a major threat to human population either by suicidal ingestion , accidental inhalation and skin contamination while spraying. Agriculture is the major occupation that is carried out in india.

Pesticides are substances used in agriculture that are intended to control pests and weeds . Those can be used in chemical warfare as biological agents Pesticides include all our herbicide, insecticide, and disinfectant.

In our country around 60% of self harm is by suicidal intend of poisoning. Organophosphorous compounds are commonly used around 80% of our total pesticide poisoning.

In our toxicology unit of poison research centre in Rajiv Gandhi government General hospital, chennnai, in the year 2017 and 2018 we had around 234 and 246 cases of organophosphorous coumpound poisoning and most of the mortality around 20 % are probably due to respirtory failure and mechanical ventilatior related complications like ventilator associated pneumonia , etc.,

AIMS AND OBJECTIVES

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1. To clinically categorise the severity of organophosphorus poisoning from admission till discharge by WHO clinical severity Paradyneia Organophosphorus Poisoning scoring system.

2. To correlate clinical severity POP scoring from admission till discharge with arterial blood gas interpretation values on Organophosphorous compound poisoning.

3. To correlate serum acetylcholinesterase values from admission and serially till discharge with arterial blood gas values interpretation and to intervene as early as possible.

4. To correlate arterial blood gas analysis with atropine requirement, duration of ventilation and hospital stay days

5. To correlate arterial blood gas analysis with one or more of complications like respiratory failure and the need for mechanical ventilation, intermediate syndrome, acute renal shutdown, convulsion, arrhythmias and coma

REVIEW OF LITERATURE

REVIEW OF LITERATURE

Historical Background

In 1837 Von Hofmann synthesized methyl phosphor chloride as first OP compound. Tetraethylpyrophosphate (TEPP), was a potent synthetic toxic OPC compound synthesized by Clermont in 1854. Schrader's group synthesized thousands of compounds, the most popular insecticide parathion .

The major threat to human community in the form of toxicity are the two major compounds mainly organophosphorous and carbamate compounds .

"Organophosphate" includes all our phosphorus- containing insecticides , phosphate containing compounds with P atom surrounded by four O atoms and other derivatives of phosphoric and phosphonic acids such as phosphonates that inhibit cholinesterase.

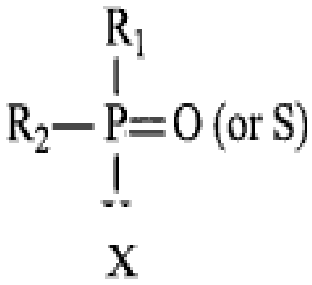
Some nerve agents had been produced in germany that are used in chemical warfare in second world war, sarin has been used in chemical terroristic attack at Tokyo, Japan.

Nowadays wide range of organophosphorous compounds have been used with Biological properties

Structure of organophosphorous compound

Organophosphorus compounds are phosphoric acid esters, otherwise called as phosphorous containing organic compounds in which centrally located phosphorous compound surrounded by 4 atoms in which one is the

terminal oxygen which is double bonded and other three are two lipophilic groups (R) and a leaving group (X) that are connected by single bond . The "leaving group" determines the OPC characteristics and classify it into four main categories, prototype compound is diflurophosphate



Class I –If there is a nitrogen at the X position, and the OP compound are collectively termed phosphorylcholines.

Class II - Fluorine molecule at the X position,OP compounds are called as fluorophosphates

Class III – If there is an cyanide molecule or a other halogen the X position, they are called as cyanophosphates

Class IV -Dimethoxy or diethoxy at the X position containing OP compounds

MECHANISM :

Three groups – reversible inhibitors , carbamoylating inhibitors and organophosphorous compounds.

PHARMACODYNAMICS AND PHARMACOKINETICS

Organophosphorous compounds absorption occurs through skin contamination, ingestion, inhalation or injection.

Both pharmacokinetics and dynamics depends upon several factors :

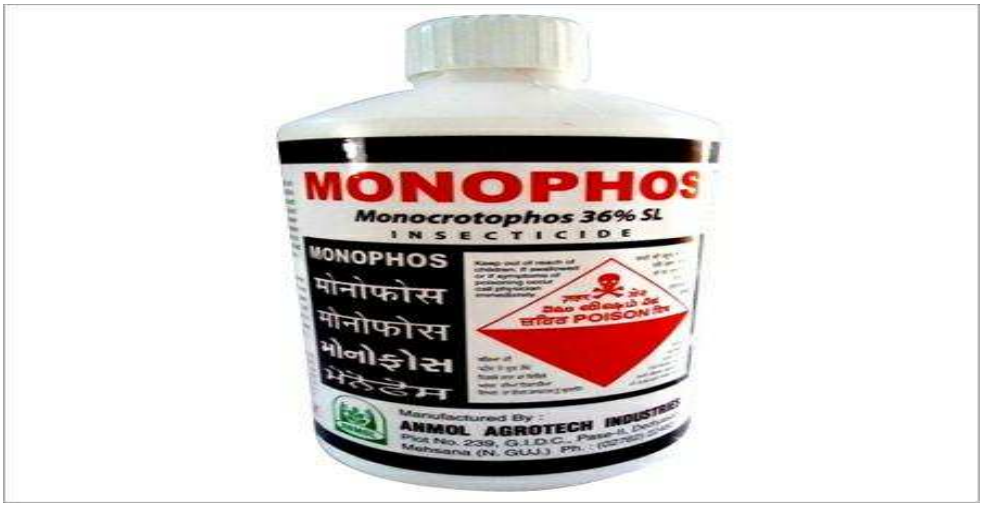
1. Route of administration, mode of absorption , bioavilability

2.Distribution to tissue sites and organs

3. Metabolism and activation

4. Mode of excretion.

Distribution is predominantly on major organs that to majority of amount around 50 % in liver and kidneys. Plasma half life ranges from few minutes to few hours, duration of symptoms is determined by property of the compound – lipid solubility, oxon activation , stability of compound and acetylcholinesterase bond and aging.. Metabolism occurs by oxidation or esterase hydrolysis.Around 80% ofcompound are excreted within 48 hours of exposure through urine and stools.lipid soluble agents may take several days to weeks to manifest symptoms and signs because the substance may be get out of the fat at later stages, whereas other compounds it takes a mean of around 8 hours.


MONOPHOS
Monocrotophos 36% SL
INSECTICIDE
MONOPHOS
मोनोफोस
मोनोफोस
મોનોફોસ
ಮೊನೊಫೊಸ್
POISON
ANMOL AGROTECH INDUSTRIES


Chlorpyrifos
480g/L EC
JINAN TIANBANG CHEMICAL CO.,LTD

CLASSIFICATION OF ORGANOPHOSPHORUS AND CARBAMATE COMPOUNDS

A.HIGHLY TOXIC

Disulfoton

Isoflurophate

Monochrotophos

Tetraethylpyrophosphate

Dicrotophos

Dichlorovas

Chlormephos

Methyl Parathion

B.MODERATELY TOXIC

Cyanophos

Dichlorphos

Chlorpyrifos

Triazophos

EPBP

Profenofos

Formothion

Diazinon

Fenthion

C.LEAST TOXIC

Bromophos

Propylthiopyrophosphate

Quinalphos

Temephos

Malathion

Dimethoate

Tetrachlorvinphos

Prophenophos

CARBAMATES

Carbaryl

Propoxur

MECHANISM OF ACTION

Neurotransmission in sympathetic , parasympathetic ganglia is mainly by acetylcholine. The place were at other sites acetylcholine acts as an neurotransmitter are postganglionic sympathetic fibres and parasympathetic nerve and also skeletal muscle neuromuscular junction , sweat gland. when nerve axon potential depolarises neuromuscular junction, vesicles containing neurotransmittrers such as ACh fuse with nerve terminals, releasing ACh into the synapse or neuro muscular junction. Acetylcholine acts both at muscarnic and nicotinic receptors.

Nicotinic receptors exists at skeletal neuromuscular junction, autonomic ganglia , adrenal medulla and in the central nervous system , whereas Muscarnic receptors are present in all organs , tissues , and all cell types Certains subtypes predominate in certain areas as like M2 in Heart and M3 in Bladder.

Acetylcholine receptor consists 5 glycosylated protein subunit 2 alpha, beta, delta and epsilon subunit ACh binds to either postsynaptic muscarnic or nicotinic receptors followed by a G protein coupled action at ligand gated muscarnic receptor leading to activation of ionic currents on nerve cells, that alters flow of Na+ , K+ , Ca+ across postsynaptic cell membrane, resulting in propagation of the action potential.

Acetylcholinesterase belongs to carboxylesterase family which is found in two forms:

1. True acetyl cholinesterase – found in tissues and red blood cell membranes
2. Pseudocholinesterase – found in serum and liver.

Organophosphates are anticholinesterse that phosphorylates esteratic site of acetyl cholinesterase enzyme similar to acetylcholine thus by causing accumulation of actylcholine in the synapse or NMJ . The reactivation of enzyme may occur spontaneously .

Active region of acetylcholinesterase contains one anionic site and an esteratic site, phosphorylated enzymes by reversible inhibitors that react extreme slow with water because of phosphorylation.

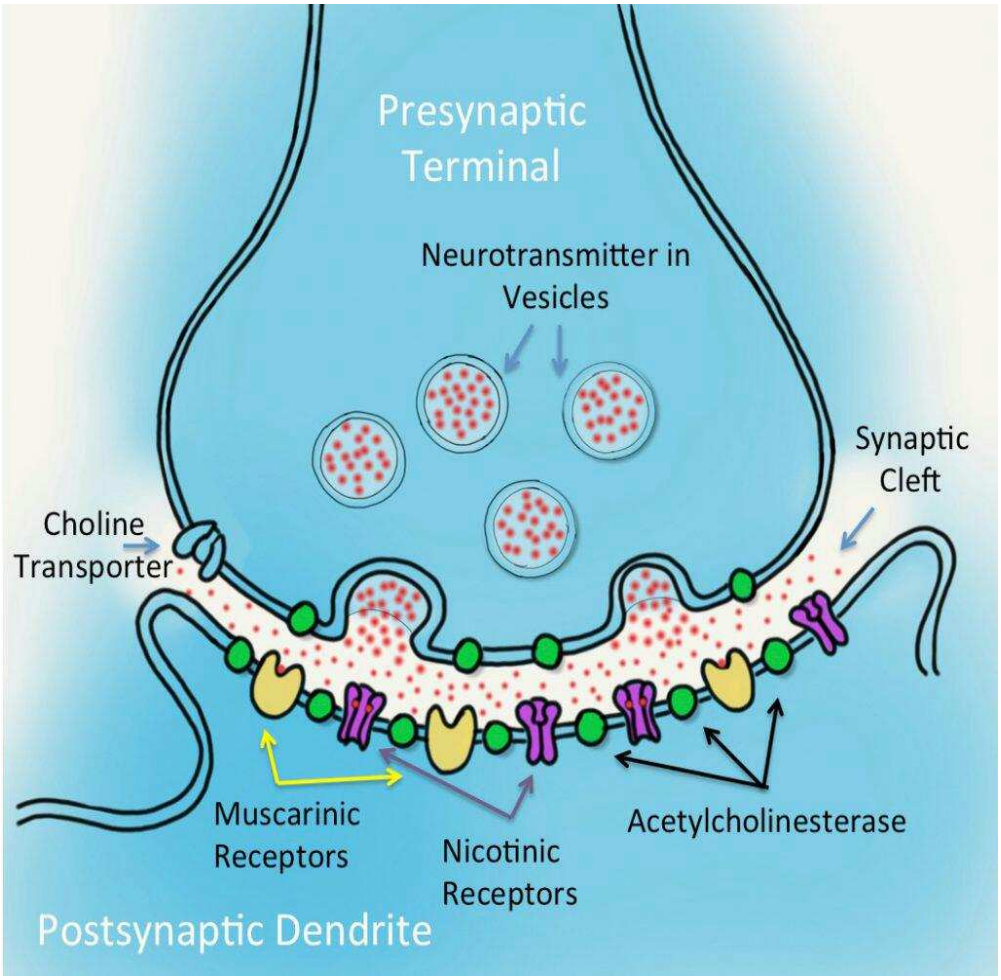
Aging is a process by which phosphorylated enzyme becomes resistant hydrolysis hence pralidoxime should be used within 24 hours

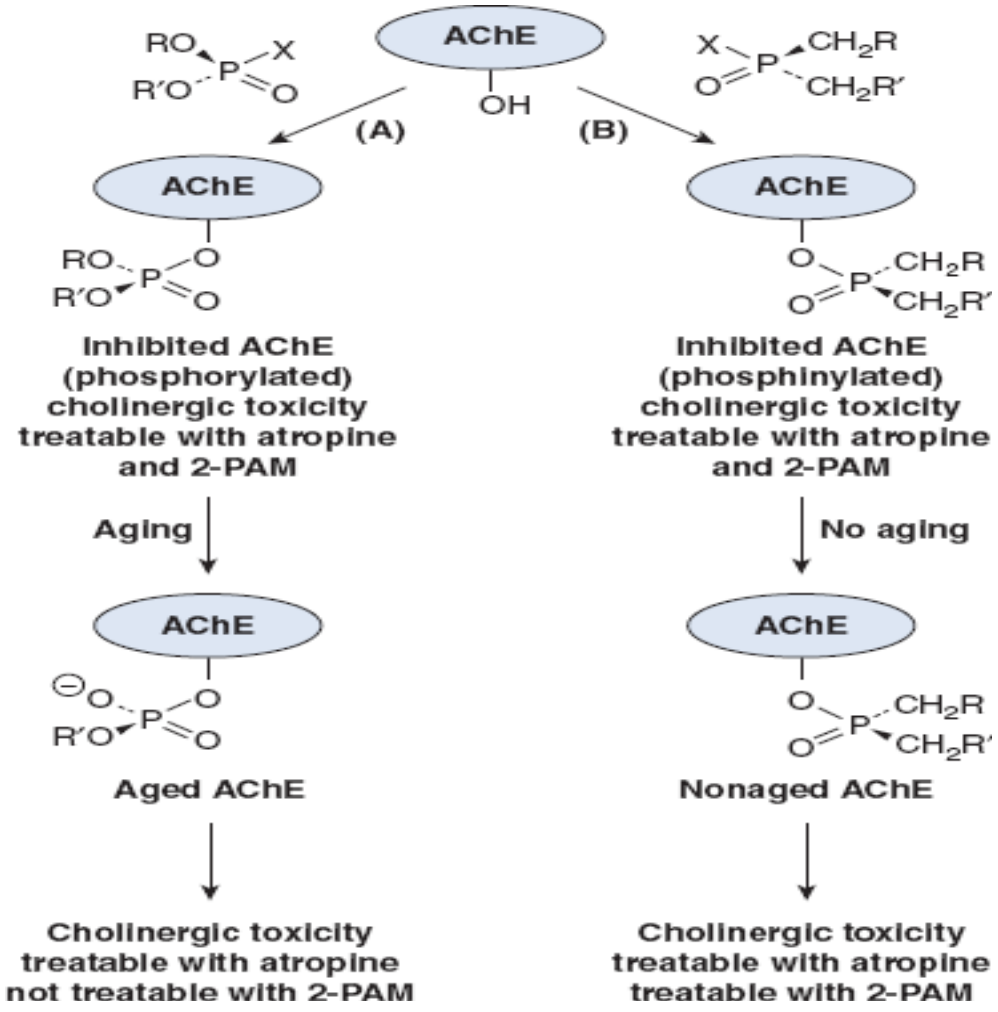
Organophosphorous compound binds to a hydroxyl group of AChE enzyme. Acetylcholinesterase splits of leaving (X) group of OPC poisoning which forms a reversible bond thus by inactivating enzyme.

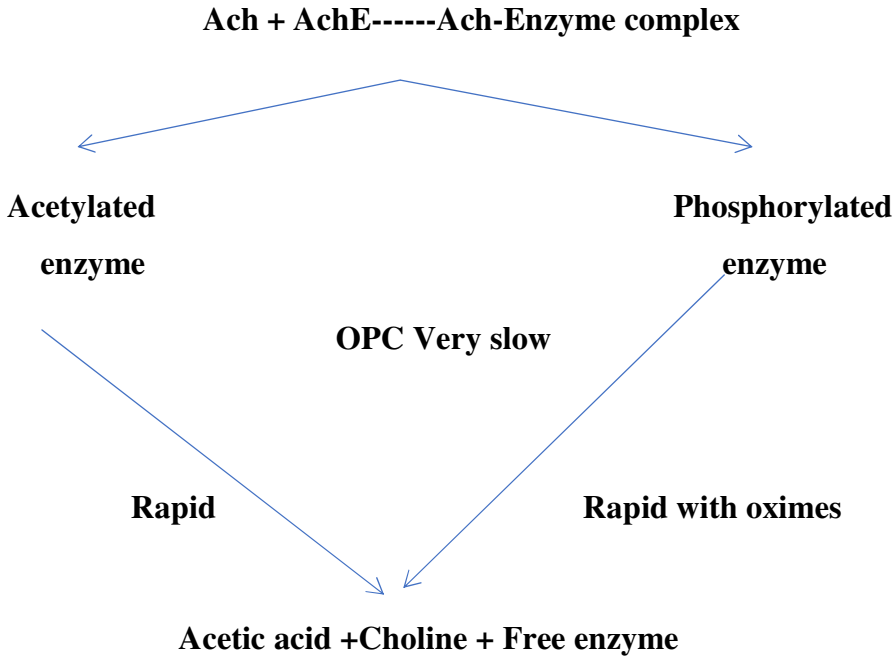
Pralidoxime or obidoxime, speed up the rate of reactivation. Spontaneous reactivation is faster in dimethoxy OPc. Half-life for spontaneous reactivation of human AChE inhibited by dimethoxyOPc is 0.7-0.8 hour,diethoxy inhibition is 30-60 hour ,this means that patients who present to a hospital 4 hours after poisoning with a dimethoxy OPc , thus after 14 hours nearly half of their total body acetylcholine are resistant to hydrolysis, hence the patients might be completely refractory to oxime therapy after fourteen hours

Normal physiological reaction is a rapid one, in which acetylcholine acetylates acetylcholinesterase enzyme which inturn forms acetylcholine-enzyme complex. The acetylated enzyme undergoes hydrolysis and forms acetic acid and choline releasing the free enzyme. Acetylated enzyme reacts with water extreme rapidly and the esteratic site is freed in fraction of seconds, whereas In organophosphorus compounds poisoning, it phosphorylates enzyme complex instead of acetylation,phosphorylation makes the reaction extremely slower one to convert it into a free enzyme.

Non-availability of free enzyme leads to excess acetylcholine in the synapse and neuromuscular junction leading onto the toxic clinical consequences. Oximes accelerate the conversion of phosphorylated enzyme to free enzyme.




AChE
OH
(A)
(B)
Inhibited AChE (phosphorylated) cholinergic toxicity treatable with atropine and 2-PAM
Inhibited AChE (phosphinylated) cholinergic toxicity treatable with atropine and 2-PAM
Aging
No aging
Aged AChE
Nonaged AChE
Cholinergic toxicity treatable with atropine not treatable with 2-PAM
Cholinergic toxicity treatable with atropine treatable with 2-PAM


Ach + AchE------Ach-Enzyme complex
Acetylated enzyme
Phosphorylated enzyme
OPC Very slow
Rapid
Rapid with oximes
Acetic acid +Choline + Free enzyme

CLINICAL FEATURES

Symptoms and signs of organophosphorus poisoning:

Both Muscarinic and Nicotinic manifestations

GASTRO-INTESTINAL

Anorexia / Nausea / vomiting

Abdominal cramps

Excessive salivation

Loose stools / Tenesmus

Involuntary defecation

CARDIO-VASCULAR

Hypotension / Low BP / Hypertension

Bradycardia / Tachycardia

Arrythmias

RESPIRATORY

Running nose

Bronchorrhea

Hyperaemia of the upper respiratory tract

Wheezing due to bronchoconstriction

Respiratory paralysis

GENITO URINARY

Urinary incontinence/ involuntary urination

EYES

Conjunctival hyperaemia / congestion on local contamination

Ocular pain

Excessive Lacrimation

Miosis may not be evident due to sympathetic discharge

GLANDS

Salivation

Localised Sweating initially later on excessively

MUSCULO-SKELETAL

Weakness

Muscle Fasciculation /Twitching might be scatterd

Cramps

Generalised weaknaess / Paralysis

CENTRAL NERVOUS SYSTEM MANIFESTATIONS

Anxiety

Confusion / Ataxia

Generalised Convulsions

Slurred speech / dysarthria

Insomnia

Tremors

Coma

Deep tendon reflexes will be absent

Respiratory and circulatory depression

Cheyne – Stokes respiration

The toxic manifestations of organophosphorus compounds depend on the type of compound, quantum of exposure, mode of administration, rate and amount of systemic absorption.

Gastrointestinal manifestations:

Symptoms of anorexia , vomiting, loose stools , involuntary defecation and abdominal cramps are first to occur after oral ingestion.

Pulmonary manifestations:

Excessive secretions due to muscarinic action cause obstruction of airways. Respiratory muscles and oropharyngeal muscles become paralysed due to nicotinic effects leading on to obstruction of upper airways and aspiration of gastric contents. Cardiopulmonary arrest occurs mainly due to depression of central nervous system..

Death is often due to respiratory secretions , inadequate ventilation and respiratory failure. Early respiratory failure during acute cholinergic crisis is unclear but likely to involve depression of central respiratory drive in ventral medulla leading to Respiratory failure, respiratory muscle weakness and pulmonary effects (bronchospasm and bronchorrhoea)

Bronchial secretions which overwhelm pulmonary function and lead to death often characterised as drowning on dry land. OPC poisoning produces cholinergic crisis by inhibition of acetylcholinesterase In central and peripheral

nervous system leading to wide range of clinical effects including central apnea, pulmonary bronchoconstriction and secretions, seizures and muscle weakness, all these results in flaccid and paralysed muscles which ultimately lead to respiratory failure and acid base disturbances.

Excess synaptic acetylcholine stimulates muscarinic receptors and then depresses or paralyses the nicotinic receptors which may cause cause carbon dioxide retention

Cardiovascular system manifestations:

Mechanisms may be due to direct toxic effects on the myocardium or due to other contributory factors like hemodynamic abnormalities, severe metabolic acidosis, hypoxia,electrolyte imbalance /disturbances or even with high doses of atropine.

They might cause most dreaded complications or even many times fatal leading to death.

Neurological manifestations:

Neuro muscular weakness or respiratory paralysis might lead to intermediate syndrome or prolonged days of ventilation leading to ventilation associated complications.

Type I paralysis or acute cholinergic crisis :

It is seen in initial phase of exposure which present with scattered muscle fasciculation, paralysis, cramps & respiratory paralysis leading to mechanical ventilation. This phase usually passes off within 2 – 3 days.

Myonecrosis have been described in this phase and leads to increased serum levels of creatine kinase muscle fraction CK-MM

Type II paralysis or Intermediate syndrome :

It usually develops within 1 – 4 days of exposure. The probable mechanisms postulated are

a. Variants in susceptibility to cholinergic receptors

b. Muscle necrosis

c. Inhibition of AchE for long time

d. Inadequate therapy with oximes

e. Muscle weakness due to oxidative stress

Weakness of neck flexors even associated with head drooping is seen in this type of paralysis.

Muscles of inspiration and expiration , proximal weakness of both upper and lower limbs and oculomotor cranial nerves like third, fourth and sixth with distal muscles sparing. This persists for a period of 4 – 18 days and even may require mechanical ventilatiory support.

Type III paralysis or organophosphate induced delayed polyneuropathy (OPIDP)

This persists for a period of 1 to 3 weeks after exposure which is usually rare toxicity due degeneration of distal axons of both central and peripheral nervous system due to distal motor axonopathy associated with cramping muscle pain in lower limb , paraesthesias and numbness, wrist drop

and foot drop with sparing of cranial nerves and ANS . There will be persistent deficits and areflexia.

Chronic Organophosphate induced neuropsychiatric disorder(COPIND)

It is one of the rare phenomenon which occurs following acute exposure to heavy doses of organophosphorus compounds. It produces long term effect with presenting features of mood liability, suicidal thoughts, irritability, attention deficit , disorientation, memory disturbances, delirium, schizophrenia, dystonic reactions, psychosis,cog-wheel rigidity. This could be attributed to the due to inhibition of acetylcholinesterase in extrapyramidal system

Immunological alterations:

Organophosphorous compounds either by direct acetylcholine action or by metabolised products of OP compounds cause immune suppression leading to decreased chemotaxis of neutrophils.

It may lead on to autoimmune reactions and can cause decreased response for vaccines. They are more prone for recurrent viral infections,

Endocrine manifestations:

There may be increased hormone release due to Increase acetylcholine acting on nicotinic receptors of brain producing excessive ACTH (Adrenocorticotrophic hormone, Antidiuretic hormone or Vasopressin, prolactin. Non-ketotic hyperglycemia associated with excess glucose in urine (glycosuria) and thyroxine production may be decreased.

CLINICAL SEVERITY SCORING:

Clinical severity scoring that are used in organophosphorus poisoning. are

1.Peradeniya Organophosphorus Poisoning (POP) scale

2.Poisoning Severity Scale (PSS)

3. Modified Dreisbach Clinical Criteria

The Peradeniya Organophosphorus Poisoning scale

		score
pupil size		
	>2mm(mydriatic)	0
	<2mm	1
	Pin point (miotic)	2
Respiratory rate		
	<20/bpm	0
	>20/bpm	1
	>20/bpm tachypnea with central cyanosis	2
Heart rate		
	>60/min	0
	41 – 60/min	1
Fasciculation	<40/min (Bradycardia)	2
Twitching	None	0
	Present, generalized / continuous	1
	Both generalized and continuous	2
Conscious level		
	Conscious and rationale	0
	Impaired response to verbal stimuli	1
	No response to verbal stimuli	2
Convulsions		
	Absent	0
	Present	1

Note : 0 – 3 Mild Poisoning Score ; 4 – 7 Moderate Poisoning Score;

8 – 11 Severe Poisoning Score

DIAGNOSTIC MODALITIEs :

I. **Enzyme Levels**:

1.**Cholinesterase**:

Reduction of RBC cholinesterase levels occurs in organophosphorous compounds poisoning.

CNS acetylcholine levels are better expressed by RBC cholinesterase levels rather than plasma cholinesterase. False positive results may be seen in pernicious anemia, hemoglobinopathies and with antimalarial drugs usage.

In organophosphorus poisoning serum cholinesterase levels will be less than 5000 IU/L . .It can be raised during pregnancy and infections. Low levels can be seen in liver disorders, hypoproiteinemia, succinylcholine, codeine, morphine drug usage etc., because it is an acute phase reactant produced in liver.

2.Creatine kinase:

Creatine kinase is expressed by various tissues like skeletal muscles, heart, brain, retina, hair and smooth muscle that catalyses the conversion of creatine to phosphocreatine by consuming ATP to form ADP.

It lies at two places within the cell

1. In Mitochondria
2. In Cytoplasm → 3 isoenzymes

CK-BB → Brain

CK-MM → Skeletal muscles

CK-MB → Heart

Serum normal range of creatine kinase 60 -400 IU/L.

In acute organophosphorus poisoning, serum CK levels are elevated in both acute cholinergic phase and intermediate syndrome due to myonecrosis , but not specific.

3. Other enzymes:

SGOT/AST, LDH, amylase, lipase may be elevated .

II. Arterial Blood gas analysis- Eventhough intubation and need for

mechanical ventilation can be assessed clinically, ABG interpretation is much needed to assess severity of presentation, prognosis, need for ventilation and clinical outcome.

Interpretation- many parameters are expressed in ABG like PH ,PaO2 , PaCo2 , Hco3- , anion gap , Na+ , k+ , cl-

PH , Hco3- , PaCo2 is the three main paremetrs needed to tell whether it is a simple or complex acid base disorder and whether it is a metabolic or respiratory disorder.

Normal values – PH (7.35 – 7.45) , PaCO2 (35-45) , Hco3- (22 - 26)

Simple acid base disorders -

Metabolic acidosis – decreased PH and bicarbonate

Metabolic alkalosis – increased PH and bicarbonate

Respiratory acidosis – decreased PH and increased Paco2

Respiratory alkalosis – increased PH and decreased Paco2

Mixed acid base disorders

Metabolic acid base disturbances with respiratory compensation or Respiratory acid base disorder with metabolic compensation

III. Aspiration of gastric contents and analysis in blood –

For estimation of organophosphate compounds.

IV. Renal Function Test:

Increased serum creatinine and blood urea nitrogen. Electrolyte imbalance - Hypokalemia / Hyperkalemia

V. Complete Blood count

Increased total leucocyte count and hematocrit due to dehydration

VI. Arterial Blood Gas analysis

Respiratory alkalosis, Respiratory acidosis, Metabolic acidosis & alkalosis

VII. Chest X Ray

Evidence of aspiration pneumoniitis, bat wing appearance or features suggestive of pulmonary edema

VIII. Electrocardiogram

P-R interval, Q-T interval can be prolonged with elevated S-T segment , sinus brady/tachycardia, ventricular tachycardia, ventricular fibrillation.

There are three phases of cardiotoxicity described by Ludomirsky et al. Phase I – Increased heart rate probably due to sympathetic drive which is for brief period

Phase II - A-V conduction abnormalities probably A-V block due to prolonged parasympathetic stimulation

Phase III - QT prolongation, Torsades de pointes, VT/VF

IX. Nerve Conduction Study :

Decremental response seen with single stimulus when repetitive firing is done.

X. Serum Magnesium

Hypomagnesemia is seen with acute organophosphorous poisoning, the mechanisms postulated are

Ryles tube suction when done for long period

Diarrhoea for a prolong period or when it is severe

Underlying illness like chronic alcoholic , decreased oral intake or starvation, diabetes, hyperthyroidism, end stage renal disease

CARDIAC

Arrythmias

Hypertension

NEUROMUSCULAR

Seizures

Muscle cramps, numbness , paraesthesias

Paralysis

Acute organic brain syndrome

Studies relating to correlation of arterial blood gas analysis in organophosphorous compounds

1. Study of acid base imbalance in organophosphorous poisoning patients Conducted at Dr.S.C. Government medical college, Vishnupuri, Nanded , Maharastra , India by Anjali Pergulwar et al, employing 50 patients of acute organophosphorous compounds .
2. A study on acid base interpretation can be the predictor of outcome among patients with acute organophosphate poisoning before hospitalisation by Jiung –Hsiun Liu et al.
3. Correlation of serum cholinesterase level, clinical score at presentation and severity of organophosphorous poisoning study done by S Rehiman et al

MANAGEMENT

General Care

* Check airway, breathing and circulation.

* Place the patient in left lateral position with minimal foot end elevation to prevent aspiration.

* Supplement high oxygen flow and intubate if needed.

* Start IV fluids of 0.9% Isotonic Saline to keep systolic blood pressure of more than 90 mmHg.

* Decontamination of skin Remove the clothes, clean the patient with water and soap

* Decontamination of eyes - Irrigate the eyes with normal saline, if there is ocular exposure.

- Gastric lavage to prevent gut absortion and aspirate as much as possible.

* Insert Ryles tube and start lavage within an hour of ingestion Clean tap water or normal saline in a hospital setting can be used , no dwell period is needed, stop lavage once the vomitus or aspirate becomes clear

Activated charcoal

It prevents absorption of organophosphorous compounds from stomach and intestine and redues its expandable property.

1 gram / kilogram of activated charcoal in multiple doses every 2 – 4 hrs for 24 – 48 hours given through Ryle's tube and is contraindicated with paralytic ileus or with intestinal obstruction.

ICU care, to monitor:

- Heart rate
- Pulse rate – to look for bradycardia
- Blood Pressure – can be hyperntension or hypotension
- Respiratory rate - tachypnea
- Temperature- cold peripheries
- Urine output
- Scattered Fasciculation / Twitching
- Arterial oxygenation / saturation (SPO2)
- Pupillary size to look for miosis
- Lung signs- like wheeze or rhonchi
- Electrocardiogram – P-R interval , Q-T interval prolongation

Atropine

Atropine is the anticholinergic agent of choice started with dose of 2 to 5 mg rapid intravenous bolus every 10 minutes till the development of signs of **atropinisation** like:

Dry axilla without secretions

Heart rate >80/min

Clear lungs without any added sounds

No more miotic pupils

Systolic BP >80mmHg

Double the dose, if the parameters are not achieved, till adequate atropinisation.

Infusion of 10 – 20% of bolus dose given to maintain atropinisation in 100 ml of normal saline and assess every 15 minutes.

The dose of atropine should be decreased hourly for the next 24 hours. Watch for atropine toxicity like delirium, confusion, urinary retention, ileus, pyrexia and tachycardia.

PRALIDOXIME (P2AM):

It reactivates the acetylcholinesterase enzyme. It has three main actions.

1.It converts directly the organophosphate compound to an inert substance.

2. It protects acetylcholinesterase enzyme from further inhibition.

3. It reactivaties alkyl phosphorylated acetylcholinesterase enzyme to free and active one by reactivation.

Initial loading dose is 30 mg/kg(children 20mg /kg) IV bolus in infusion followed by 8 mg/kg/hr for next 48 hours . 1 – 2 gm IV tds for next 5 day should be given as infusion in 100 – 200 ml of Normal Saline over an hour. Pralidoxime does not penetrate central nervous system and causes reactivation of skeletal muscle AchE than at autonomic sites.

Start pralidoxime as early as possible since after 12 hours OP –enzyme complex becomes resistant to hydrolysis.

Maximum dose 12 gram in first 24 hours and titrate the dose according to clinical response.

High doses or accumulation of oximes inhibit AchE and cause neuromuscular blockade, increased diastolic blood pressure and seizures, etc.,

Pralidoxime action is most marked at nicotinic receptor at neuromuscular junction. Drug should be started early before permanent binding of op compound to acetylcholinesterase enzyme.

IV Magnesium Sulfate

Intravenous magnesium sulphate is found to be beneficial in organophosphorus poisoning. Mechanisms postulated are:

1.It reduces acetylcholine release from presynaptic terminals by blocking ligand gated calcium channels.

2.Membrane stabilization of ventricular muscle cell which prevents arrhythmias

3. Hydrolysis is increased in some pesticides.

Sodium bicarbonate

Sodium bicarbonate will increase the blood pH, bicarbonate levels, Various studies have shown it reduces mortality and morbidity that is independent of correction of acidosis.

Seizures

Treated with IV sedatives belonging to benzodiazepine group diazepam 10 – 20 mg IV or Lorazepam 4 mg IV.

Atropine induced delirium

Treated with IV short acting benzodiazepine like midazolam 0.1 mg/kg or diazepam 10 – 20 mg IV.

Mechanical ventilation

Intubation and mechanical ventilation is much needed in respiratory paralysis or central apnea leading to respiratory failure.

THERAPIES UNDER TRIAL

Organophosphorus hydrolases

Isolated from Pseudomonas organism which clears organophosphorous compound thus reducing the blood and tissue concentration.

*** N.Methyl / D-Aspartate (NMDA) receptor antagonists**

***Gancyclidine** reduces neuronal cell death, improves electroencephalogram and clinical recovery.

Butrylcholinesterase replacement therapy

This is accentuated by administration of fresh frozen plasma and plasmaparesis which increases the enzyme levels in the blood and neutralize the organophosphorus compounds.

α-2 adrenergic receptor agonists

Clonidine inhibits acetylcholine release from presynaptic terminals of neuromuscular junctions.

Extracorporeal clearance

It will be beneficial for some non-fat soluble organophsphorus compounds.

PREVENTION AND EDUCATION

Improved regulations of pesticides availability and modifications of packaging of pesticides may all help reduced the use of organophosphates compounds as poison. Proper and adequate education to public, regular training of health care professionals, establishment of poison information centres will reduce morbidity and mortality related to OPC compound poisoning. Accidental poisoning can be prevented by keeping the insecticides out of reach to children.

Proper protective universal precautions should be taken by agricultural workers while spraying pesticide or insecticide to prevent accidental inhalation or contamination . Pesticide poisoning is more common among rural areas because of agricultural usage. Pesticide poisoning contributes more than 60% of cases in our toxicology ICU , Poison research centre and carries the mortality of around 19% (case register 2017 – 18).

MATERIALS AND METHODS

MATERIALS AND METHODS

This study was conducted in our toxicology unit, poison research centre, Institute of Internal Medicine, Rajiv Gandhi Government General Hospital, Chennai. It was a cross sectional prospective study done during the period from August 2017to January 2018.

50 patients, admitted as a case of acute organophosphorus poisoning with exposure within 24 hours irrespective of route of exposure, age and sex were selected and subjected for study with the consent.

Exclusion Criteria

1. Other pesticide poisoning.
2. Other co morbities causing acid base disturbances like end stage renal disease, Chronic lung disease, diabetes causing acidosis
3. Mixed poisoning.
4. Consumption of poison with alcohol .

Peradeniya Organophosphorus Poisoning scales were applied to patients assesed clinically and classified according to severity

They were subjected to basic blood investigations like renal function test including random blood sugar , serum urea and creatinine, liver function test, serum acetylcholinesterase, ECG

They also have been subjected to estimation of arterial blood gas analysis on admission ,serially, and time of discharge.

Laborotory investigations and the methods employed

1. Serum Cholinesterase : Kinetic Calorimetric method
2. Arterial blood gas estimation

Clinical severity by POP scoring were correlated with arterial blood gas analysis and serum cholinesterase levels from admission till discharge or death serially. Patients are treated with atropine, pralidoxime, benzodiazeoines if needed, intubation and mechanical ventilation with our routine protocol with intensive care monitoring of heart rate, pulse rate, blood pressure, arterial oxygenation by saturation, urine output, renal parameters and liver enzymes and electrocardiogram. Need for Intubation and Mechanical ventilation is assessed clinically, arterial blood gas estimation is correlated with requirement of atropine dose, need for mechanical ventilation, acute renal failure, intermediate syndrome, convulsions and coma.

STATISTICAL METHODS

The data was analysed using SPSS software. Pearsons correlation coefficient and p value were calculated to find the statistical significance. Variables were considered to be significant if p value < 0.05.

Statistical analysis was done using SPSS software. The following statistical methods have been employed for analysis:

- Chi-square test
- Paired t-test
- Unpaired student t-test
- Pearson coefficient
- Analysis of variance (ANOVA)

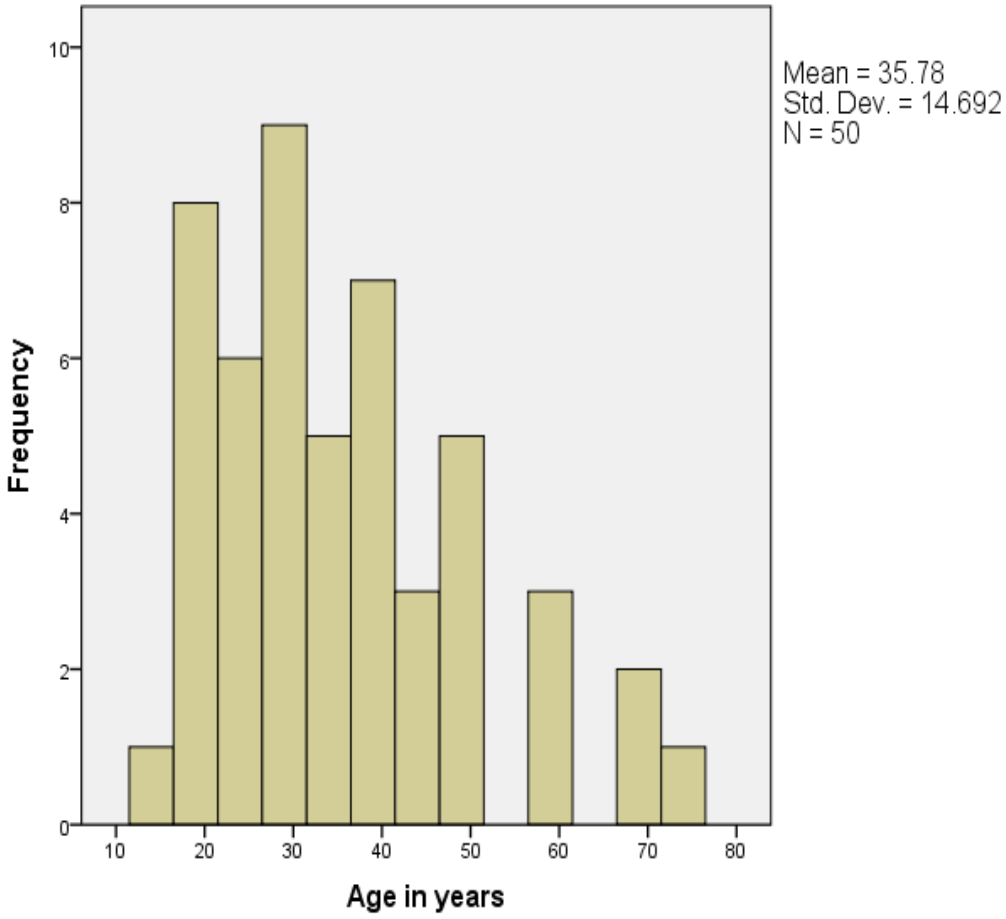
OBSERVATION AND RESULTS

OBSERVATION AND RESULTS

RESULTS

DESCRIPTION OF STUDY POPULATION

GRAPH -I AGE DISTRIBUTION



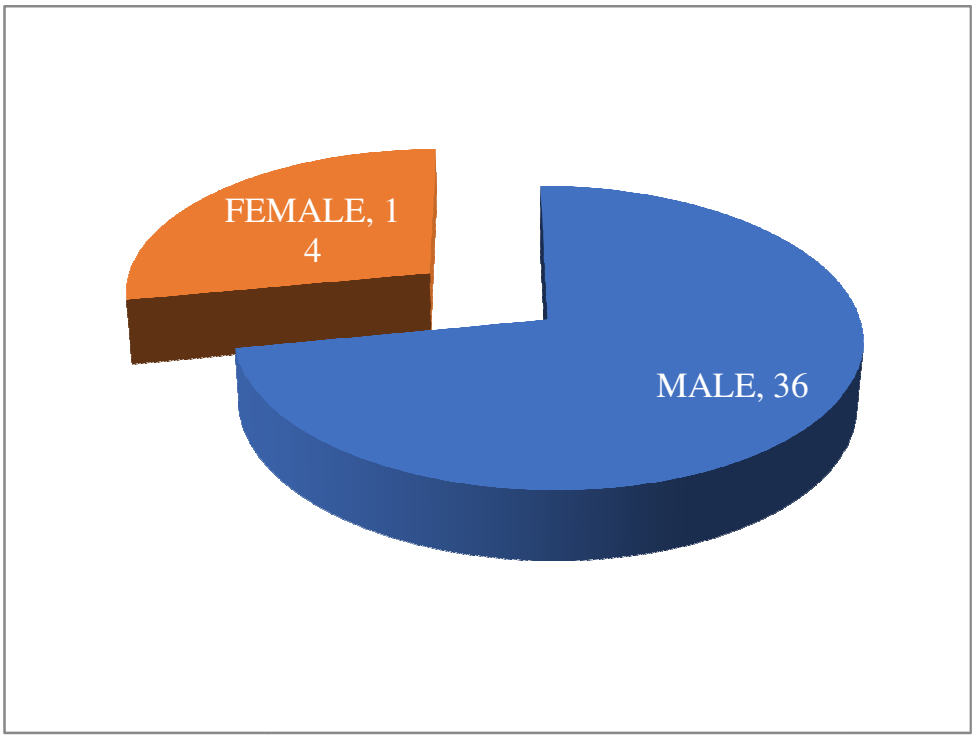
In our study population the majority forms between 20 – 30 years of age, next is 30-40 years and 41-50 years of age

TABLE-I SHOWING AGE DISTRIBUTION

Age Categories	Frequency	Percent
<= 20 years	6	12.0
21 - 30 years	18	36.0
31 - 40 years	10	20.0
41 - 50 years	10	20.0
51 - 60 years	3	6.0
61 - 70 years	3	6.0
Total	50	100.0

Totally 38 patiens of our study population are under 50 years of age.

GRAPH-II Distribution of Sex of the subjects in the study population



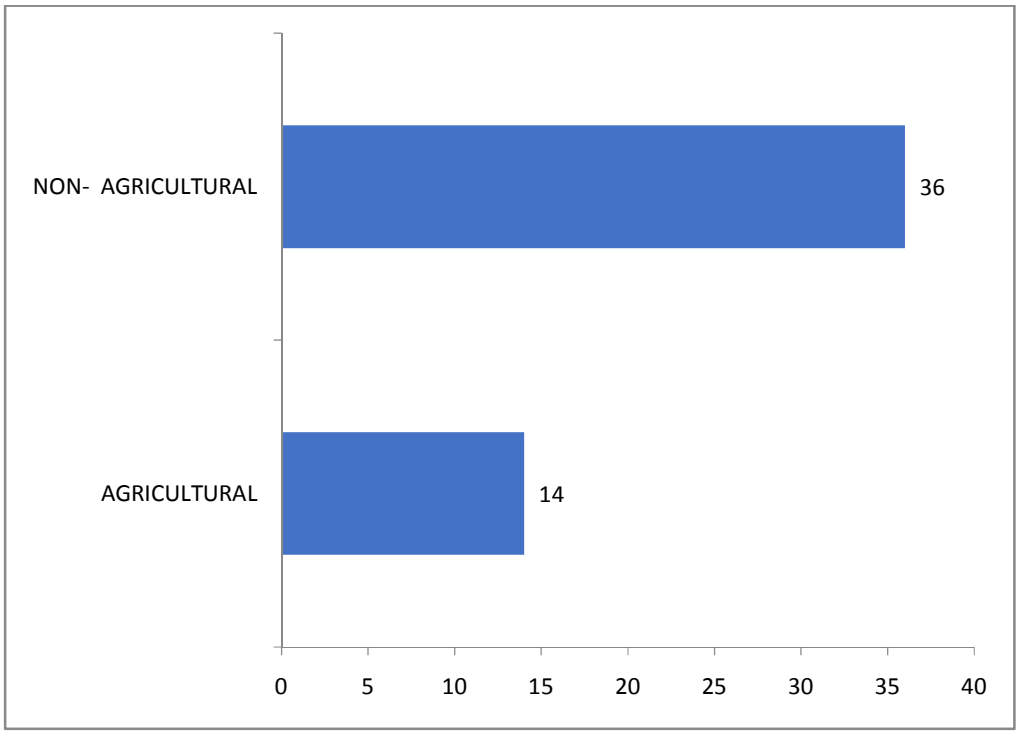
In our study population male population predominates with 72%

TABLE-II

	Frequency	Percent	Valid Percent	Cumulative Percent
MALE	36	72.0	72.0	72.0
FEMALE	14	28.0	28.0	28.0
Total	50	100.0	100.0	100.0

TABLE & GRAPH III

Showing Distribution of occupation of the subjects in the study population

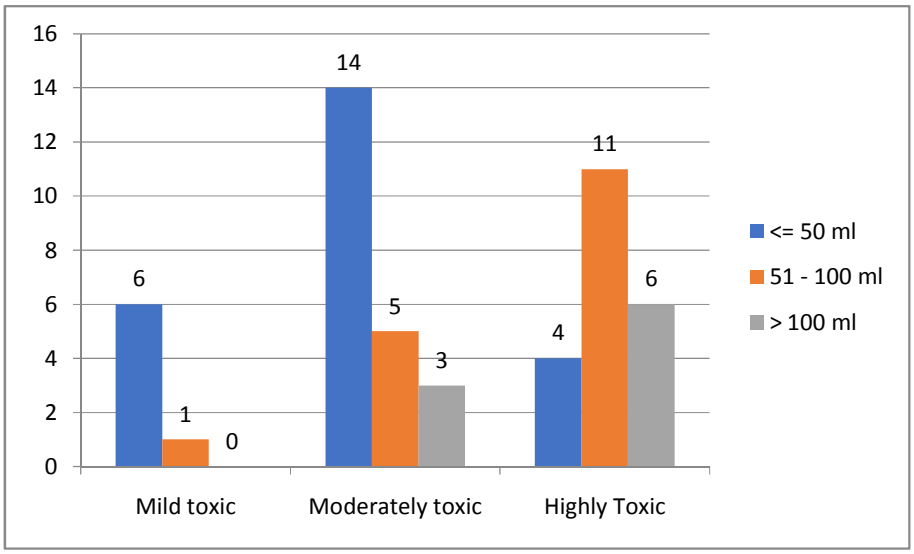


Agriculture make only 28 %in our study population . Non – Agriculture by occupation predominates.

In our study population all individuals were exposed to organophosphorous compounds by ingestion only .

	Frequency	Percent	Valid Percent	Cumulative Percent
AGRICULTURAL	14	28.0	28.0	28.0
NON-AGRICULTURAL	36	72.0	72.0	100.0
Total	50	100.0	100.0	

Graph & Table - IV Distribution of toxicity of OPC with the quantity ingested by the subjects in the study population



In our study population most of them consumed moderately toxic compounds that to maximum of less than 50 ml quantity.

	Frequency	Percent	Valid Percent	Cumulative Percent
<= 50 ml	24	48.0	48.0	48.0
51 - 100 ml	17	34.0	34.0	82.0
> 100 ml	9	18.0	18.0	100.0
Total	50	100.0	100.0	

TABLE IV - I

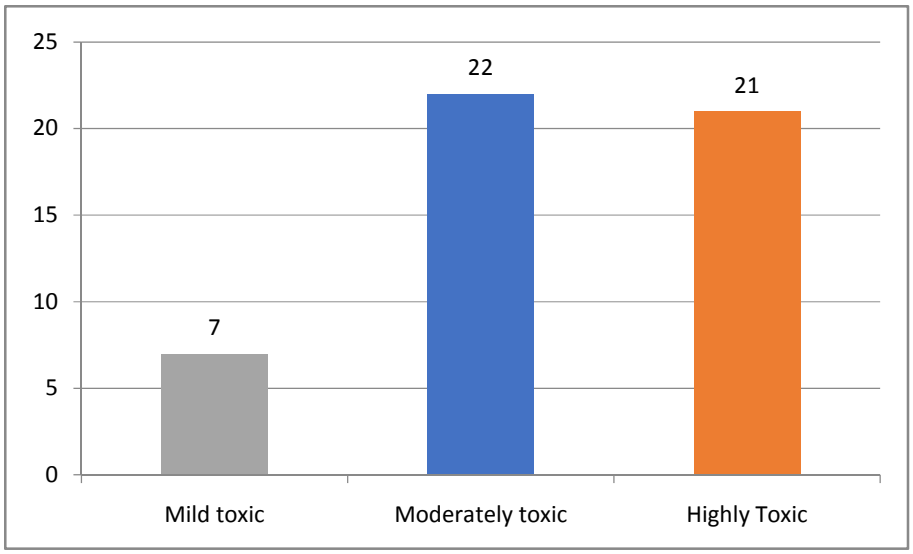
Quantity of OPC	N	Mean duration of symptoms (days)	Std. Deviation	p value by ANOVA
<= 50 ml	24	4.29	3.747	0.071
51 - 100 ml	17	6.24	4.630	
> 100 ml	9	7.89	4.076	
Total	50	5.60	4.271	

There is a positive correlation found between the amount of exposure to compounds and mean duration of symptoms as well as it can be done with outcome.

Table & Graph –V Distribution of toxicity of OPC ingested by the subjects in the study population

Toxicity of OPC

	Frequency	Percent	Valid Percent	Cumulative Percent
Mild toxic	7	14.0	14.0	14.0
Moderately toxic	22	44.0	44.0	58.0
Highly Toxic	21	42.0	42.0	100.0
Total	50	100.0	100.0	



In our study population 14 % consumed least toxic compounds, 42% consumed highly toxic and 44% consumed moderately toxic compounds

Table-VI

Toxicity of OPC	N	Mean duration of symptoms (days)	Std. Deviation	p value by ANOVA
Mild toxic	7	5.57	4.577	0.956
Moderately toxic	22	5.41	5.011	
Highly Toxic	21	5.81	3.459	
Total	50	5.60	4.271	

There is no correlation found between the type / toxicity of compounds with mean duration of symptoms.

There is a correlation found between level of toxicity of compounds with clinical severity and also between quantum of exposure and clinical Severity scoring.

In our study population patients consumed mild toxic compounds had only mild to moderate severity scoring whereas in moderately toxic compound ingested patient had equal clinical soring of mild to severe , patients consumed highly toxic compounds had around 76 % of severe POP scoring.

In our study population patients who have consumed more than 100 ml of Compound had, only severe clinical POP scoring from admission till discharge or death.

The severity of poisoning makes the patients seeking health care earlier and there is a significant correlation.

Table –VII Comparison between Clinical severity scoring and toxicity / quantum of exposure of compounds

Toxicity of OPC	POP Score categories			P value by Chi sq test
	Mild	Moderate	Severe	
Mild toxic	5 (71.42%)	2 (28.57%)	0 (0%)	0.001
Moderately toxic	7 (31.81%)	7 (31.81%)	8 (36.36%)	
Highly Toxic	1 (4.76%)	4 (19.04%)	16 (76.19%)	
Total	13 (26%)	13 (26%)	24 (48%)	
Quantity of OPC	**POP Score categories**			**P value by chi sq test**
	Mild	**Moderate**	**Severe**	
<= 50 ml	12 (50%)	11 (45.83%)	1 (4.16%)	<0.001
51 - 100 ml	1 (5.88%)	2 (11.76%)	14 (82.35%)	
> 100 ml	0 (0%)	0 (0%)	9 (100%)	
Total	13 (26%)	13 (26%)	24 (48%)	

Table –VIII Comparison between clinical severity scoring and serial mean acetylcholinesterase values

POP Score Categories	AchE levels	Mean	Std. Error	95% Confidence Interval		p value by ANOVA
				Lower Bound	Upper Bound	
Mild	**Day 1**	4671.636	348.444	3966.249	5377.024	<0.001
	Day 2	4527.091	363.951	3790.311	5263.871	
	Day 3	5521.364	392.422	4726.946	6315.781	
	Discharge	5600.636	387.338	4816.512	6384.761	
Moderate	**Day 1**	3128.818	348.444	2423.430	3834.206	<0.001
	Day 2	2704.455	363.951	1967.674	3441.235	
	Day 3	4045.091	392.422	3250.673	4839.508	
	Discharge	5190.455	387.338	4406.330	5974.579	
Severe	**Day 1**	620.263	265.126	83.543	1156.983	<0.001
	Day 2	645.684	276.925	85.079	1206.290	
	Day 3	1037.000	298.589	432.539	1641.461	
	Discharge	1905.947	294.720	1309.318	2502.577	

There is a clear correlation found between clinical severity POP scoring and Mean serial acetylcholinesterase values. Since patients with severe POP scoring had reduced mean acetylcholinesterase values from admission till discharge / death.

Table –IX Comparison between clinical severity scoring and serial mean ABG PH

POP Score Categories	ABG pH	Mean	Std. Error	95% Confidence Interval		p value by ANOVA
				Lower Bound	Upper Bound	
Mild	**Day 1**	7.414	0.029	7.354	7.474	<0.001
	Day 2	7.412	0.023	7.365	7.459	
	Day 3	7.398	0.017	7.363	7.433	
	Discharge	7.398	0.016	7.365	7.431	
Moderate	**Day 1**	7.401	0.028	7.344	7.458	<0.001
	Day 2	7.401	0.022	7.356	7.446	
	Day 3	7.396	0.017	7.363	7.430	
	Discharge	7.404	0.016	7.372	7.435	
Severe	**Day 1**	7.433	0.021	7.390	7.476	<0.001
	Day 2	7.435	0.017	7.401	7.469	
	Day 3	7.426	0.013	7.401	7.452	
	Discharge	7.418	0.012	7.394	7.442	

As clinical severity scoring of opc poisoning is associated with reducing pH values in serial monitoring , since ($p<0.001$). As patients mean PH with severe scoring has highest values from day 1 till discharge /death , as most of them had alkalosis. Those with moderate scoring had mixed values with both acidotic and alkalosis Those with mild scoring had normal PH .

Table- X

Clinical severity POP scoring and serial mean bicarbonate levels

POP Score Categories	HCO3	Mean	Std. Error	95% Confidence Interval		p value by ANOVA
				Lower Bound	Upper Bound	
Mild	**Day 1**	24.900	1.247	22.374	27.426	<0.001
	Day 2	25.000	1.178	22.614	27.386	
	Day 3	25.000	1.161	22.647	27.353	
	Discharge	24.500	0.828	22.822	26.178	
Moderate	**Day 1**	22.182	1.189	19.773	24.590	<0.001
	Day 2	22.727	1.123	20.452	25.002	
	Day 3	23.091	1.107	20.848	25.334	
	Discharge	23.818	0.790	22.218	25.418	
Severe	**Day 1**	23.158	0.904	21.325	24.990	<0.001
	Day 2	23.947	0.854	22.216	25.678	
	Day 3	24.000	0.842	22.293	25.707	
	Discharge	23.263	0.601	22.046	24.481	

There is a clear correlation between clinical POP severity scoring and Serial mean bicarbonate values with negative correlation. Patients with any of clinical score had normal bicarbonate values since most of them had respiratory paralysis and most are either respiratory alkalosis and acidosis.

Table- XI Comparison between clinical POP severity scoring and serial mean ABG PaCO2 values

POP Score Categories	PaCO2	Mean	Std. Error	95% Confidence Interval		p value by ANOVA
				Lower Bound	Upper Bound	
Mild	**Day 1**	41.200	6.368	28.298	54.102	<0.001
	Day 2	40.400	14.922	10.166	70.634	
	Day 3	39.900	2.275	35.291	44.509	
	Discharge	39.500	2.029	35.389	43.611	
Moderate	**Day 1**	40.455	6.071	28.153	52.756	<0.001
	Day 2	66.909	14.227	38.082	95.736	
	Day 3	39.455	2.169	35.060	43.849	
	Discharge	38.455	1.935	34.535	42.374	
Severe	**Day 1**	43.632	4.620	34.271	52.992	<0.001
	Day 2	38.842	10.825	16.908	60.776	
	Day 3	39.158	1.650	35.814	42.501	
	Discharge	39.316	1.472	36.333	42.298	

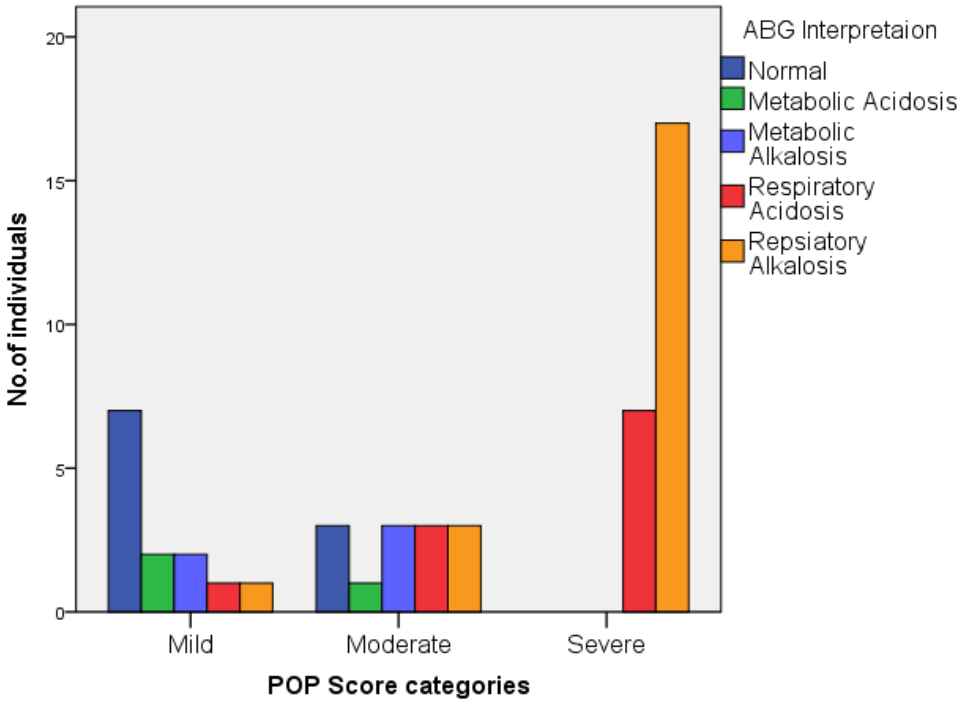
There is a correlation found between clinical severity scoring and serial mean PaCO2 values.

Since patients with severe POP scoring had increased PaCO2 values as in respiratory acidosis , as well as respiratory alkalosis which is predominantly seen in our study population with reduced PaO2 and PaCO2.

Table – XII Comparison between clinical POP severity scoring and ABG interpretation in our study population

ABG Interpretaion	POP Score categories			P value by Chi sq test
	Mild	Moderate	Severe	
Normal	7 (53.84%)	3 (23.07%)	0 (0%)	<0.001
Metabolic Acidosis	2 (15.38%)	1 (7.69%)	0 (0%)	
Metabolic Alkalosis	2 (15.38%)	3 (23.07%)	0 (0%)	
Respiratory Acidosis	1 (7.69%)	3 (23.07%)	7 (29.16%)	
Repsiatory Alkalosis	1 (7.69%)	3 (23.07%)	17 (70.83%)	
Total	13 (100%)	13 (100%)	24 (100%)	

Graph – VI showing clinical severity scoring and ABG interpretation



Opc compounds cause multiple pulmonary complication like respiratory muscle paralysis by its nicotinic action, increased pulmonary seretions by its muscarnic actions, leading to aspiration pneumonitis and pneumonia that can be ventilator associated.

Thus patients those with severe clinical scoring had only respiratory acid base disturbances with predominating respiratory alkalosis due to reduced partial pressure of oxygen and co2 wash out, next to which comes respiratory acidosis with co2 retention.

Table –XIII Comparison between clinical POP severity scoring and atropine dosing / duration of hospital stay/ventiloation duration

POP score		N	Mean	Std. Deviation	95% Confidence Interval for Mean		p value by ANOVA
					Lower Bound	Upper Bound	
Atropine Dose	**Mild**	13	4.538	3.4548	2.451	6.626	<0.001
	Moderate	13	9.462	13.0934	1.549	17.374	
	Severe	24	21.708	7.6697	18.470	24.947	
	Total	50	14.060	11.4382	10.809	17.311	
Duration of ventilation days	**Mild**	13	.308	.7511	-.146	.762	0.001
	Moderate	13	1.385	3.9484	-1.001	3.771	
	Severe	24	4.625	4.0947	2.896	6.354	
	Total	50	2.660	3.9518	1.537	3.783	
Hospital Stay Days	**Mild**	13	3.08	.862	2.56	3.60	0.067
	Moderate	13	5.85	4.598	3.07	8.62	
	Severe	24	6.96	5.835	4.49	9.42	
	Total	50	5.66	4.893	4.27	7.05	

There is a correlation between clinical severity POP scoring and atropine dosing , duration of hospital days , duration of ventilation. As clinical severity increases the need for atropine dosage increase, duration of ventilation days ($p \leq 0.001$).

Duration of hospital stay increases with clinical severity .

Table –XIV Comparison between clinical severity POP scoring and Intermediate syndrome & Graph -VII

POP Score categories	Intermediate syndrome		Total	Fisher exact p value
	Yes	No		
Mild	0 (0%)	13 (100%)	13 (100%)	0.0034
Moderate	2 (15.38%)	11 (84.61%)	13 (100%)	
Severe	9 (37.5%)	15 (62.5%)	24 (100%)	
Total	11 (22%)	39 (78%)	50 (100%)	

Clinical severity POP scoring correlates with intermediate syndrome 37.5 % of patients going for intermediate syndrome belong to severe category

Graph-VII Comparison between clinical severity POP scoring and Intermediate syndrome & Graph -VII

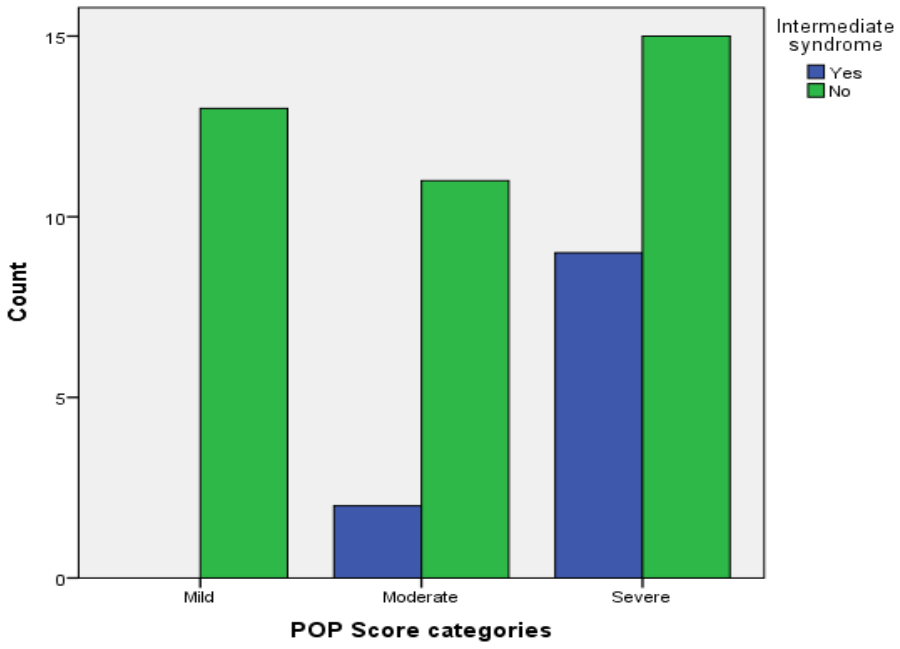


Table –XV Comparison between ventilator requirement and clinical severity scoring &Graph -VIII

POP Score categories	Ventilator		Total	p value by Chi sq test
	Yes	No		
Mild	2 (15.38%)	11 (84.61%)	13 (100%)	<0.001
Moderate	2 (15.38%)	11 (84.61%)	13 (100%)	
Severe	24 (100%)	0 (0%)	24 (100%)	
Total	28 (56%)	22 (44%)	50 (100%)	

Graph VIII showing correlation between ventilator requirement and clinical severity scoring, as severity increases ventilation is required

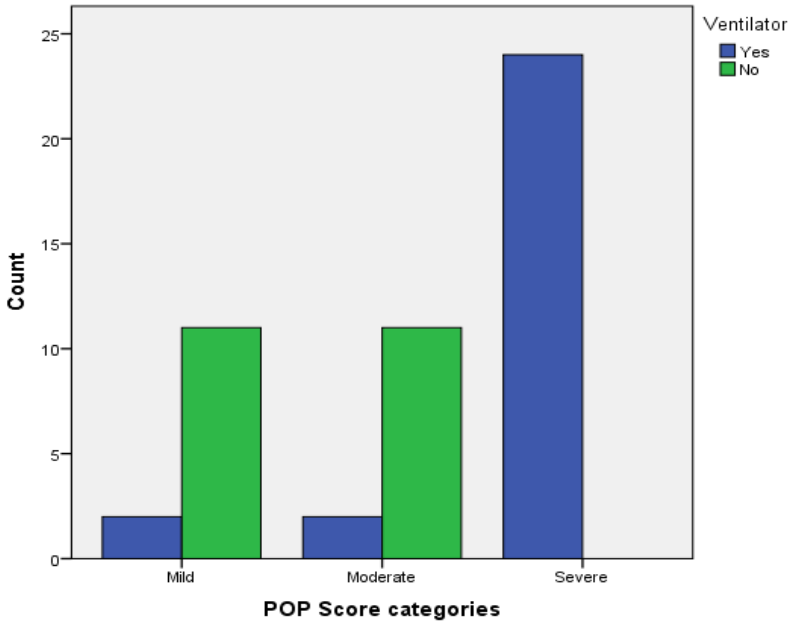


Table - XVI Comparison between clinical severity scoring and complications

POP Score categories	Complications		Total	p value by Chi sq test
	Yes	No		
Mild	2 (15.38%)	11 (84.61%)	13 (100%)	<0.001
Moderate	1 (7.69%)	12 (92.3%)	13 (100%)	
Severe	22 (91.66%)	2 (8.33%)	24 (100%)	
Total	25 (50%)	25 (50%)	50 (100%)	

There is a correlation between clinical severity POP scoring with complications like respiratory paralysis , arrhythmias , intermediate syndrome

Graph-IX showing correlation between complications of opc poisoning with clinical POP scoring

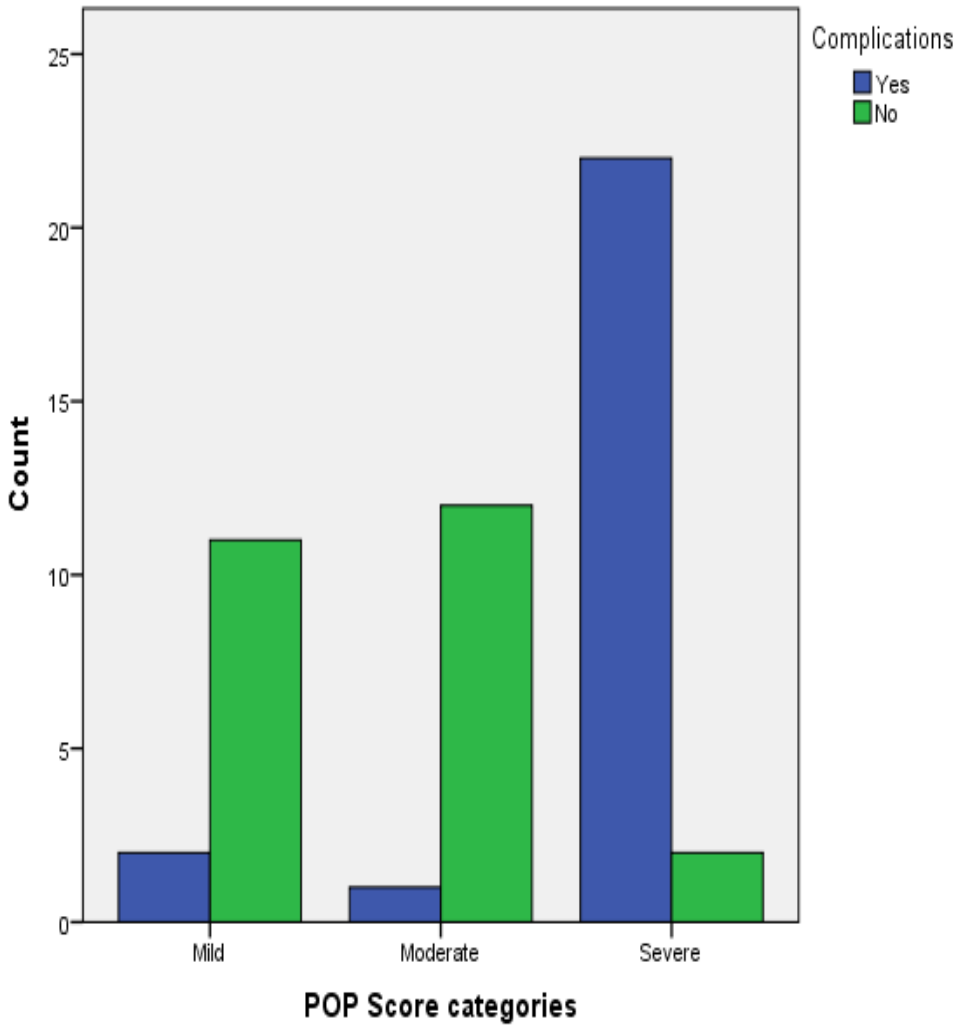


TABLE-XVII

COMPARISON BETWEEN CLINICAL OUTCOME AND CLINICAL SCORING

POP Score categories	Outcome		Total	$\chi 2(0.05)$
	Death	Discharged		
Mild	0 (0%)	13 (100%)	13 (100%)	<0.001
Moderate	0 (0%)	13 (100%)	13 (100%)	
Severe	20 (83.33%)	4 (16.66%)	24 (100%)	
Total	20 (40%)	30 (60%)	50 (100%)	

Graph X showing clinical outcome and clinical severity scoring

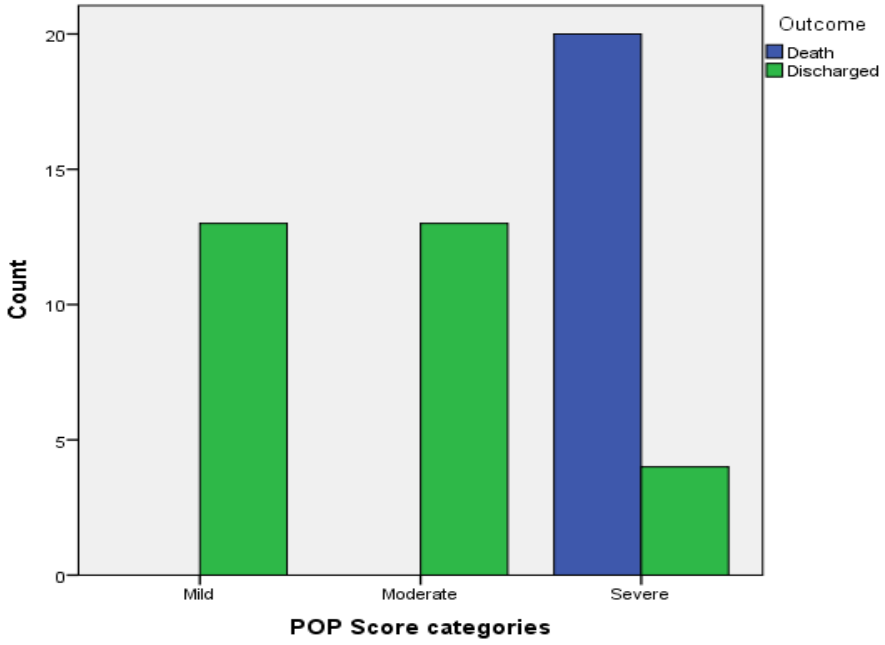


Table- XVIII Comparison between acid base disorders in ABG interpretation and intermediate syndrome

ABG Interpretaion	Intermediate syndrome		Total	P VALUE BY Chi sq test
	Yes	No		
Normal	0 (0%)	10 (100%)	10 (100%)	<0.001
Metabolic Acidosis	0 (0%)	3 (100%)	3 (100%)	
Metabolic Alkalosis	0 (0%)	5 (100%)	5 (100%)	
Respiratory Acidosis	5 (45.45%)	6 (54.54%)	11 (100%)	
Repsiatory Alkalosis	6 (28.57%)	15 (71.42%)	21 (100%)	
Total	11 (22%)	39 (78%)	50 (100%)	

Patients with respiratory acid base disorders rather than metabolic are prone for intermediate syndrome.

Although patients with intermediate syndrome most of them had respiratory alkalosis and respiratory acidosis.

GRAPH-XI SHOWING CORRELATION BETWEEN INTERMEDIATE SYNDROME AND INTERPRETATION OF ARTERIAL BLOOD GAS ANALYSIS.

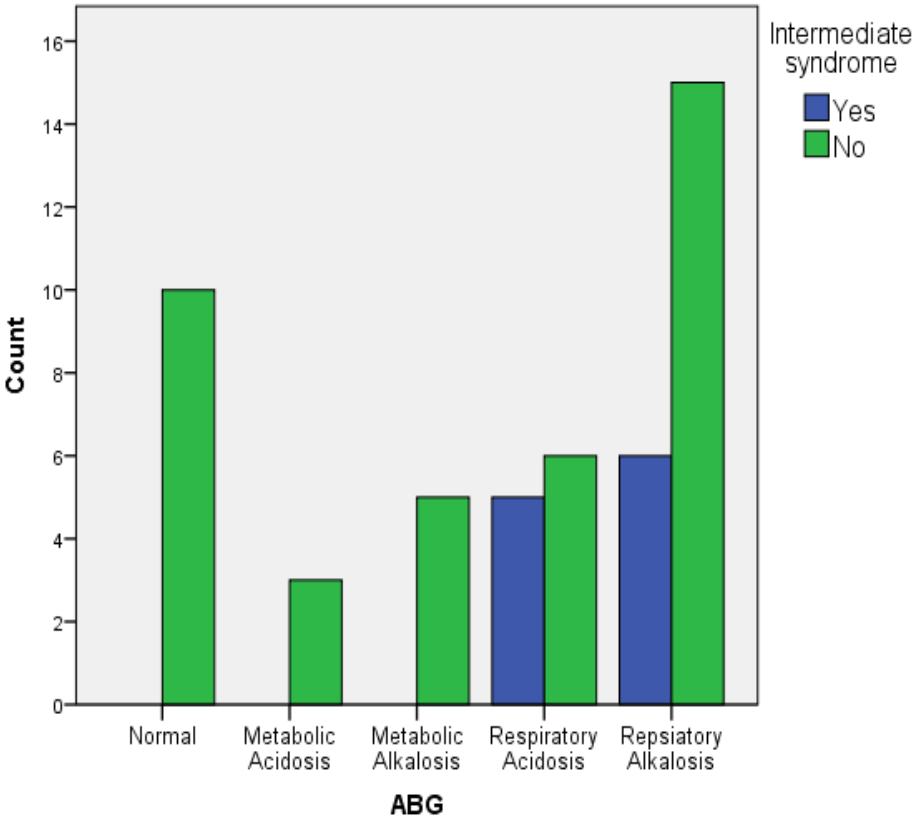


TABLE-XIX COMPARISON BETWEEN

VENTILATOR REQUIREMENT AND ABG INTERPRETATION

ABG Interpretaion	Ventilator		Total	P VALUE BY Chi sq test
	Yes	No		
Normal	0 (0%)	10 (100%)	10(100%)	<0.001
Metabolic Acidosis	0 (0%)	3 (100%)	3 (100%)	
Metabolic Alkalosis	0 (0%)	5 (100%)	5 (100%)	
Respiratory Acidosis	10 (90.9%)	1 (9.09%)	11 (100%)	
Repsiatory Alkalosis	17 (80.95%)	4 (19.04%)	21 (100%)	
Total	28 (56%)	22 (44%)	50 (100%)	

Ventilator requirement is not assessed with ABG interpretation, instead the need for intubation and mechanical ventilation is assessed clinically.

Most of the patients whom required ventilator had either respiratory alkalosis predominantly due to PaCO2 wash out and reduced partial pressure of oxygen or respiratory acidosis due to co2 retention.

Graph-XII

Showing correlation between ventilator requirement and ABG interpretation

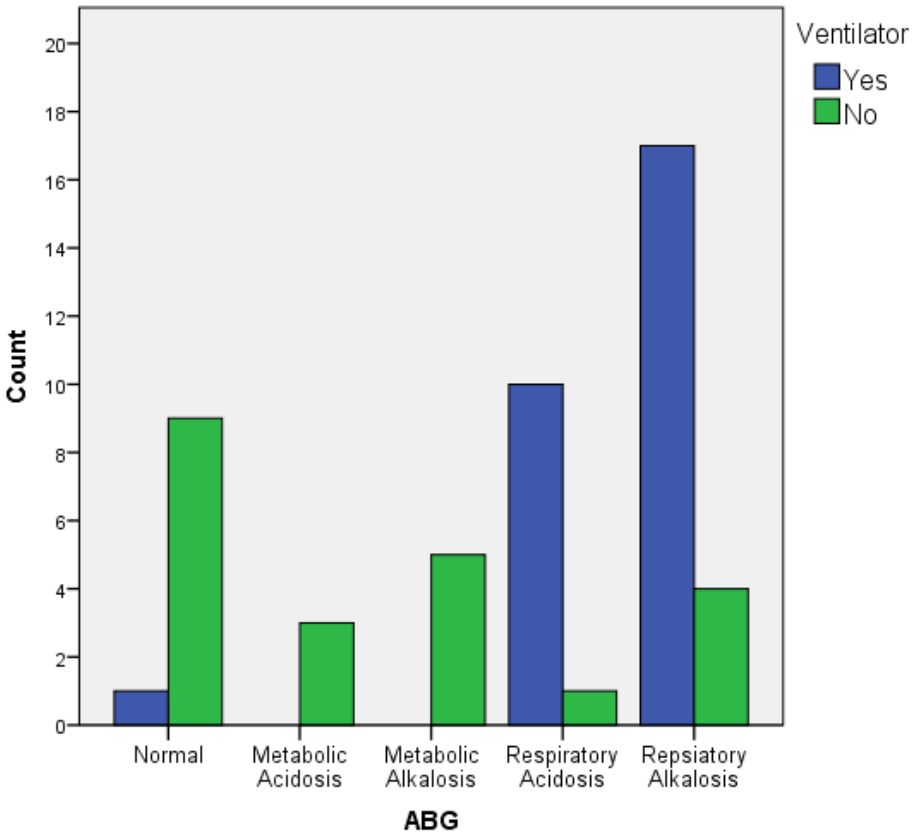


Table-XX

Comparing complications associated with opc compounds and ABG interpretation

ABG Interpretaion	Complications		Total	P VALUE BY Chi sq test
	Yes	No		
Normal	1 (10%)	9 (90%)	<0.001	<0.001
Metabolic Acidosis	0 (0%)	3 (100%)	3 (100%)	
Metabolic Alkalosis	0 (0%)	5 (100%)	5 (100%)	
Respiratory Acidosis	8 (72.72%)	3 (27.27%)	11 (100%)	
Repsiatory Alkalosis	16 (76.19%)	5 (23.8%)	21 (100%)	
Total	25 (50%)	25 (50%)	50 (100%)	

Complications like respiratory paralysis, arrhythmias, intermediate syndrome are commonly associated with respiratory alkalosis or acidosis.

Graph-XIII showing correlation between complications due to opc poisoning and acid base disturbances in ABG analysis

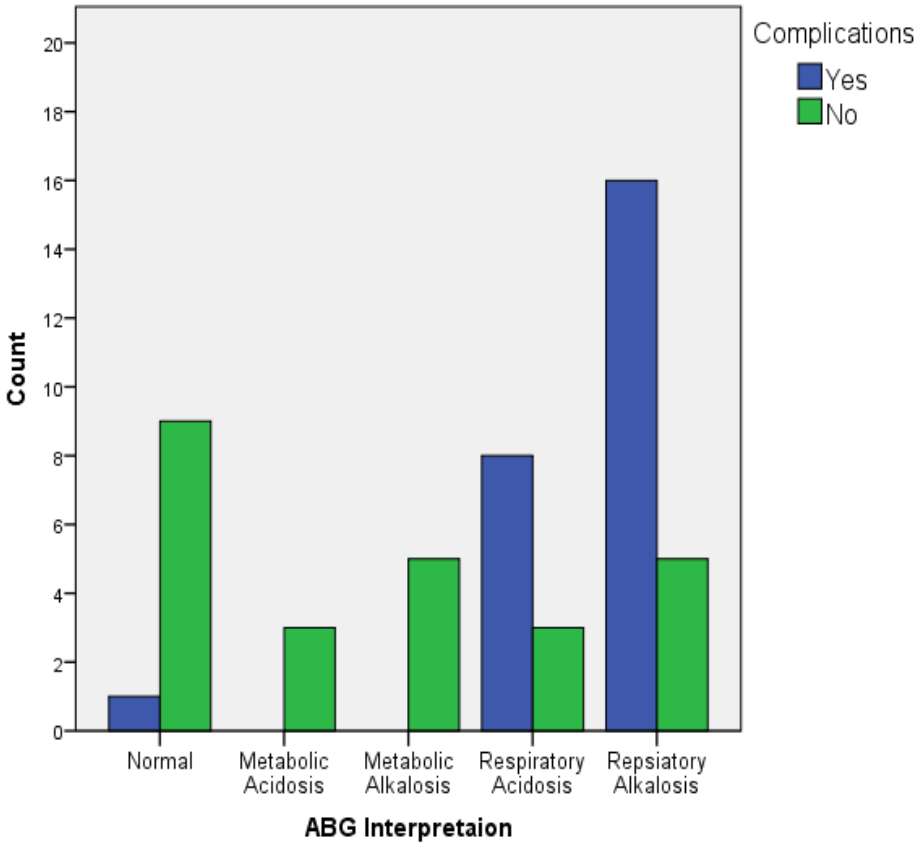


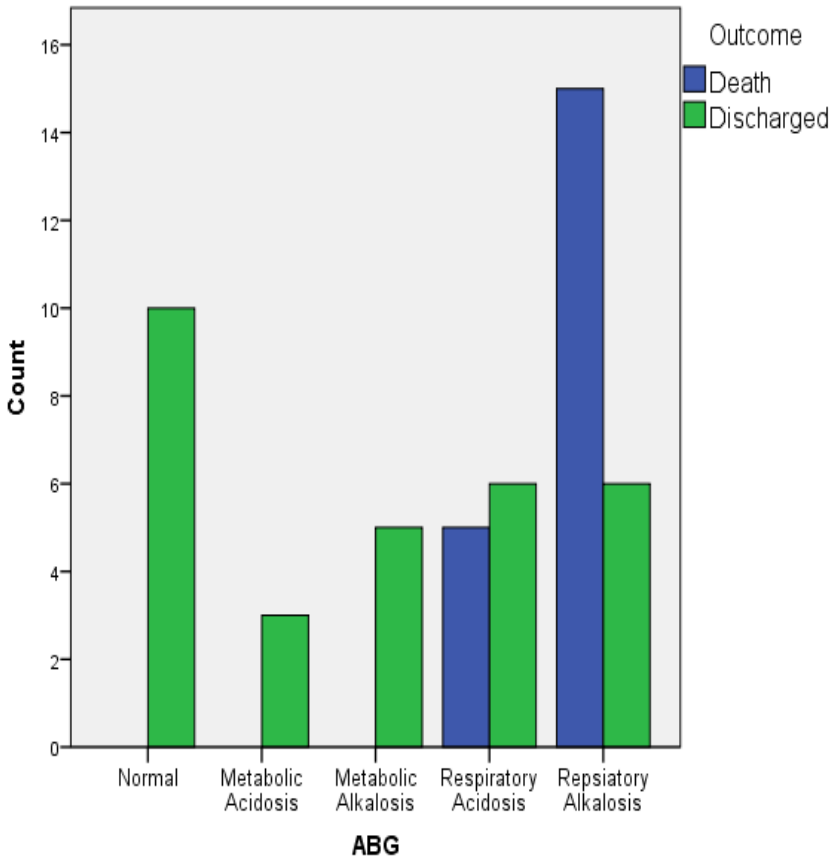
Table-XXI

Comparison between clinical outcome and acid base disturbances in ABG Interpretation

ABG Interpretaion	Outcome		Total	P VALUE BY Chi sq test
	Death	Discharged		
Normal	0 (0%)	10 (100%)	<0.001	<0.001
Metabolic Acidosis	0 (0%)	3 (100%)	3 (100%)	
Metabolic Alkalosis	0 (0%)	5 (100%)	5 (100%)	
Respiratory Acidosis	5 (45.45%)	6 (54.54%)	11 (100%)	
Repsiatory Alkalosis	15 (71.42%)	6 (28.57%)	21 (100%)	
Total	20 (40%)	30 (60%)	50 (100%)	

Mortality is associated with respiratory paralysis which are associated with either respiratory alkalosis predominantly and acidosis to some extent.

Graph-XIV showing correlation between clinical outcome and ABG interpretation



DISCUSSION

DISCUSSION

Comprehensive analysis of 50 cases of acute Organophosphorus poisoning.

Epidemiology of Organophosphorus poisoining

AGE DISTRIBUTION :

In this series, the organophosphorus poisoning was most prevalent in the age group 21 – 30 years. 28 cases out of 50 were below the age of 40 years. Pyar Ali et al observed the mean age group of 28.6 ±9.8 years from Karachi.

Another study from Karachi by AftabTurab et al observed the age group of 15– 20 years (44.77%) was predominant. Murat Sungur et al from Turkey observed the mean age group as 30 ±15 years. Karalliedde L., Senanayake N.et al of Srilanka documented 91% of their cases were under the age of 30.

Malik et al from Kashmir, revealed the predominant population affected were under the age of 25. In Mangalore, Karnataka, India, the most common age group to be affected between 20 – 30 (36.6%). KuntalBattacharyya et al of Kolkata reported the mean age of 25.5 years.

This young age group affected by exposure and also in terms of procurement and productivity. This study throw light on the target age group by improving the management protocol and decreasing the mortality.

SEX DISTRIBUTION :

In our series, males (n=36) dominated the study population. Malik et al observation of 122 cases in Kashmir valley (females n=114, males n=50), In Mangalore and Srilanka the pattern of case series with male predominance. S.Shivakumar and K.Raghavan et al of Tamilnadu reported 165 cases of organophosphorus73 poisoning and sex distribution was with male predominance. KuntalBattacharya et al from Kolkata showed male predominance.

In Southern part of India, males are actively involved in spraying fertilizers and pesticides.

OCCUPATION DISTRIBUTION :

In our case series, 14 out of 50 (28 %) were agriculturists. Non agriculturist were exposed more to organophosphorus compounds with the suicidal intent. Agriculturist, also accidentally exposed due to the spraying in the field. In Kashmir Valley, two third of the population who had exposed were engaged in apple orchard.

ROUTE OF EXPOSURE :

In our series, most of the cases occurred due to ingestion (100%) and No one had accidental inhalation (0%).

FREQUENCY OF EXPOSED :

The common organophosphorus compounds abused in our series are chlorpyrifos and Monochrotophos . Kuntal Bhattacharyya et al also escribed the most frequent compound as Chlorpyrifos(38.1%).

CLINICAL SEVERITY SCORE :

Peradeniya organophosphorous poisoning scale as a predictor of respiratory failure and mortality in organophosphorous poisoning was a study conducted by Pradeep et al published at 2017 which included 50 patients and 6 parameters in clinical scoring with incidence of respiratory failure in 23 (46%) patients and death in around 66.6% individuals of severe scoring.

Correlation of serum cholinesterase level, clinical score at presentation and severity of organophosphorous poisoning by S Rehiman et al Studied 50 patients using peradenya organophosphorous compounds in Which severity directly correlated with serum cholinesterase level.

Jiung –Hsiun Liu et al made a study on acid base interpretation can be the predictor of outcome among patients with acute organophosphate poisoning before hospitalisation.

In a 9 year retrospective study of 82 patients, they were grouped into 4- without acidosis, metabolic acidosis, respiratory acidosisand mixed acidosi Found that mortality rate of op poisoned patients with metabolic acidosis was 25% and respiratory acidosis was 50 %

LABORATORY CORRELATES :

SERUM ACETYLCHOLINESTERASE :

Serum acetylcholinesterase levels are monitored from admission till discharge or death in patients with acute organophosphorous compound poisoning. In our study, serum cholinesterase levels are correlated with the clinical severity by Peradyneia organophosphorous poisoning scale, prolonged duration of hospital stay, prolonged duration of mechanical ventilation, increased need for atropine dosage. It also correlated with the incidence of complications and outcome. Thus with the morbidity and mortality it had the pattern of negative correlation.

ARTERIAL BLOOD GAS ANALYSIS :

Eventhough arterial blood gas analysis has multiple parameters including PH, PaCO2, PaO2,HCO3- , Na+ , K+ , Cl- , Anion gap , So2.

But for interpretation of simple acid base disorders only PH, HCO3- , PaCO2 is enough and most common acid base disturbances seen among our study is Respiratory alkalosis and next to which is Respiratory acidosis probably due to respiratory paralysis , central apnea and pulmonary secretions.

In many studies metabolic acidosis which is proven fatal, but in our study both Metabolic acidosis and alkalosis can be managed, but the respiratory component which needs mechanical ventilation is proven fatal.

CONCLUSION

CONCLUSION

1. Peradeniya Organophosphorus Poisoning scale is a much needed clinical assessment scale for categorising the severity of cases with acute organophosphorus poisoning.
2. Serum acetylcholinesterase levels which correlates with clinical Severity scoring has been proved by many studies to provide aggressive treatment.
3. Arterial blood gas estimation eventhough not available in many peripheral hospitals has to be done to interpret the acid base disturbances and treat accordingly and as soon as possible. Since respiratory acidosis as well as alkalosis can be managed by mechanical ventilation and metabolic acidosis can be treated with bicarbonate.

SUMMARY

SUMMARY

Case fatality rate comes around 60% in developing countries where there are many changes in treatment protocol and research activities. Henceforth we proceeded with a study including 50 patients correlating arterial blood gas analysis with clinical severity peradeniya organophosphorous poisoning score and serum acetylcholinesterase levels at our toxicology unit, poison research centre, Institute of Toxicology, Rajiv Gandhi Government General Hospital, Chennai.

There is a direct correlation between clinical severity POP scoring and serum acetylcholinesterase values from admission till discharge/ death and correlation between clinical severity and ABG interpretation in which many of patient with severe POP scoring and less acetylcholinesterase values had respiratory alkalosis and respiratory acidosis

In our study population of 50 patients around 10(20%) of the individuals who presented with mild scoring had normal ABG values.

Around 21(42%) individuals who had respiratory alkalosis at presentation with severe 17 (70%) clinical scoring on admission due to respiratory paralysis.

In patients with respiratory acidosis around 11(22%) individuals had severe Clinical scoring 7 (29%) on admission till discharge Probably this severity that is correlating with respiratory acid base disorders are due to pulmonary complications like respiratory paralysis and pulmonary secretions, central apnea, and bronchospasm leading on to co2 wash out, decreased partial

pressure of oxygen and co2 retention is seriously fatal however with poper and adequate ventilation some of them managed to survive.

In our study population of 50 individuals around 6% of them had metabolic acidosis in which all of them had better outcome no mortality , as it can be treated with IV sodabicarbonate

Around 10% of individuals had metabolic alkalosis in their arterial blood gas Interpretation with almost all of them had a better prognosis, without any complications like respiratory failure with need for mechanical ventilation, intermediate syndrome, with no mortality similar to metabolic acidosis

22 % of patients of total population went in for respiratory acidosis that can be interpreted in ABG probably due pulmonary secretions , central apnea Leading to CO2 retention in the pulmonary alveoli and other complications , intermediate syndrome, need for mechanical ventilation for intubation and mechanical vemntilation done, eventough around 45 % of them had poor prognosis and outcome.

In our study around 42 % of individuals , the majority had respiratory Alkalosis probably due to decrease respiratory drive , respiratory paralysis leading to decreased partial pressure of oxygen in blood due to poor diffusion across the alveoli and CO2 washout with increased complications, intermediate syndrome and poor prognosis and outcome.

RECOMMENDATIONS

Research into the correlation between op compound poisoning and acid base alteration and cause for respiratory acidosis and respiratory alkalosis in organophosphorus poisoning is worth to be considered.

The role of arterial blood gas status in organophosphorus poisoning needs to be studied since the exact cause of alteration in blood PH, PCO2 and bicarbonate values are unclear.

Many studies around worldwide had questioned about the use of oximes, hence, a randomized control trial comparing the current WHO recommended guidelines with placebo is required to evaluate the need of pralidoxime in acute organophosphorus poisoning.

Use of fresh frozen plasma therapy,organophosphorus hydrolases derived from pseudomonas, Butrylcholinesterase replacement therapy, extra corporeal clearance, alpha 2 recptor adrenergic agonist to improve survival and reduce complications need to be studied.

LIMITATIONS OF THE STUDY

Since our study has been conducted in only in 50 individuals and also included patients who had consumed opc poisoning in very mild doses and least Toxic compounds. Hence around 20 % of individuals in our study had normal arterial blood gas values. It could not be applied for the entire population, the treatment should be individualised.

Although in many studies metabolic acidosis is prove fatal , we got only 6 % with metabolic acidosis and all of them had good outcome Arterial blood gas gives good parameters to know about acid base disorders But it could not be used everywhere and anywhere because of its cost and availability.

Since many of the centers analyse clinically the need for intubation and mechanical ventilation.

But as for as concerned arterial blood gas analysis is essential to know about the acid base status and correct accordingly and intervene as soon as possible.

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ANNEXURES

PLAGIARISM CERTIFICATE

This is to certify that this dissertation work titled "**CORRELATION OF ARTERIAL BLOOD GAS ANALYSIS IN PREDICTIG OUTCOME OF ACUTE ORGANOPHOSPHOROUS COMPOUND POISONING**" of the candidate **Dr.S.MUKIL,** with registration Number **201611014** for the award of **M.D** in the branch of **GENERAL MEDICINE.** I personally verified the urkund.com website for the purpose of plagiarism check. I found that the uploaded thesis file contains from introduction to conclusion pages and result shows 17 percentage of plagiarism in the dissertation.

Guide & Supervisor sign with Seal.

PATIENT CONSENT FORM

Study Detail	:	**"CORRELATION OF ARTERIAL BLOOD GAS ANALYSIS IN PREDICTIG OUTCOME OF ACUTE ORGANOPHOSPHOROUS COMPOUND POISONING"**
Study Centre	:	Rajiv Gandhi Government General Hospital, Chennai.
Patient's Name	:	
Patient's Age	:	
Identification Number	:	

Patient may check (√) these boxes

I confirm that I have understood the purpose of procedure for the above study. I have the opportunity to ask question and all my questions and doubts have been answered to my complete satisfaction. ❑

I understand that my participation in the study is voluntary and that I am free to withdraw at any time without giving reason, without my legal rights being affected. ❑

I understand that sponsor of the clinical study, others working on the sponsor's behalf, the ethical committee and the regulatory authorities will not need my permission to look at my health records, both in respect of current study and any further research that may be conducted in relation to it, even if I withdraw from the study I agree to this access. ❑

I understand that my identity will not be revealed in any information released to third parties or published, unless as required under the law. I agree not to restrict the use of any data or results that arise from this study. ❑

I agree to take part in the above study and to comply with the instructions given during the study and faithfully cooperate with the study team and to immediately inform the study staff if I suffer from any deterioration in my health or well being or any unexpected or unusual symptoms. ❑

I hereby give consent to participate in this study. ❑

I hereby give permission to undergo detailed clinical examination and blood investigations as required ❑

Signature of investigator

Signature/Thumb impression

Study investigator Name:

Dr.S.MUKIL

Patient name and address

PROFORMA

NAME :

AGE/SEX :

IP No. :

OCCUPATION :

II.POISONING

COMPOUND	
AMOUNT	
TIME OF CONSUMPTION	

III.SYMPTOMS:

VOMITING	
LOOSE STOOLS	
SALIVATION/LACRIMATION/SWEATING	
DYSPNOEA	
BLURRING OF VISION	
SEIZURES	
LOSS OF CONSCIOUSNESS	

IV.PAST HISTORY:

DIABETES MELLITUS	
HYPERTENSION	
BRONCHIAL ASTHMA/COPD	
TUBERCULOSIS	

V.PERSONAL HISTORY:

SMOKING	
ALCOHOLISM	

VI.SYSTEMIC EXAMINATION:

CVS	
RS	
ABDOMEN	
CNS	

VII.INVESTIGATIONS:

CBC	
LFT	
RFT	
SERUM ELECTROLYTES	
RBS	
URINE(R/E)	
ECG	

ANNEXURE IV

PERADENIYA ORGANOPHOSPHORUS SCALE

PARAMETERS	0	1	2	SCORE
PUPIL SIZE	≥2 mm	<2mm	PINPOINT	
RESPIRATORY RATE	<20/min	≥20/min	≥20/min with central cyanosis	
HEART RATE	>60/min	41-60/min	<40/min	
FASCICULATION	None	Present Generalised/continuous	Both generalised and continuous	
LEVEL OF CONSCIOUSNESS	Conscious and rationale	Impaired response to verbal commands	No response to verbal commands	
SEIZURE	Absent	Present	-	
GRADE	Mild(0-3)	Moderate(4-7)	Severe(8-11)	

ANNEXURE V

SERIAL ESTIMATION OF ARTERIAL BLOOD GAS ANALYSIS

	DAY 1	DAY 2	DAY 3	ON DISCHARGE
CLINICAL SCORING				
SERUM ACETYLCHOLINESTERASE				
ARTERIAL BLOOD GAS ANALYSIS				
ATROPINE REQUIREMENT				-
COMPLICATIONS IF ANY				-
DURATION OF HOSPITAL STAY				

INFORMATION SHEET

We are conducting a study on **"CORRELATION OF ARTERIAL BLOOD GAS ANALYSIS IN PREDICTIG OUTCOME OF ACUTE ORGANOPHOSPHOROUS COMPOUND POISONING"** among patients attending Rajiv Gandhi Government General Hospital, Chennai and for that your specimen may be valuable to us.

The purpose of this study Acute organophosphorus compound poisoning is very common among patients admitted to casualty in our hospitals. Methods to diagnose, monitor and prognosticate are non specific. There is a need to develope the parameters other than clinical in these patients for the better outcome.

We are selecting certain cases and if you are found eligible, we may be using your blood samples to do certain tests.

The privacy of the patients in the research will be maintained throughout the study. In the event of any publication or presentation resulting from the research, no personally identifiable information will be shared.

Taking part in this study is voluntary. You are free to decide whether to participate in this study or to withdraw at any time; your decision will not result in any loss of benefits to which you are otherwise entitled.

The results of the special study may be intimated to you at the end of the study period or during the study if anything is found abnormal which may aid in the management or treatment.

Signature of Investigator Signature of Participant

Date :
Place :

URKUND

Urkund Analysis Result

Analysed Document:	correlation of arterial blood gas analysis in predicting outcome of acute organophosphorous compounds plagiarism.docx (D42428824)
Submitted:	10/11/2018 3:38:00 PM
Submitted By:	beatmukil@gmail.com
Significance:	17 %

Sources included in the report:

siva thesis final 2.docx (D31037382)

Instances where selected sources appear:

47

ஆய்வு ஒப்புதல் படிவம்

ஆராய்ச்சி தலைப்பு

"ஆர்கனோ பாஸ்பரஸ் நச்சுத்தன்மையின் விளைவுகளை
முன்னறிவிப்பதில் தமணி இரத்தப் பகுப்பாய்வு"

பெயர்: தேதி:
வயது: வெளி நேயாளி எண்:
பால்: ஆராய்ச்சி சேர்க்கை எண்:

இந்த ஆராய்ச்சியின் விவரங்களும் அதன் நோக்கங்களும் முழுமையாக எனக்கு தெளிவாக விளக்கப்பட்டது. விளக்கப்பட்ட விஷயங்களை நான் புரிந்துகொண்டு நான் எனது சம்மதத்தை தெரிவிக்கிறேன்.

மேற்கண்ட பரிசோதனையின்போது ஏற்படக்கூடிய பின்விளைவுகளையும் முழுவதும் உணர்ந்து இந்த பரிசோதனைக்கு மனமார சம்மதிக்கிறேன்.

நான் ஆராய்ச்சியாளருடன் ஒத்துழைப்பேன் என்றும், எனக்கு ஏற்படக்கூடிய அசாதாரண நிகழ்வுகள் பற்றியும் உடனடியாக ஆராய்ச்சியாளரிடம் தெரிவிப்பேன் என்று உறுதி கூறுகிறேன். இந்த ஆய்விலிருந்து எப்போது வேண்டுமானாலும் எக்காரணமும் கூறாமல் என்னை விடுவித்துகொள்ளலாம் என்பதை அறிவேன்.

என்னிடம் இருந்து பெறப்படும் தகவல்களை அரசு, வரைமுறை அதிகாரிகள் ஆகியோர்களுடன் பகிர்ந்துகொள்ள ஆராய்ச்சியாளருக்கு அனுமதி அளிக்கிறேன். என்னுடைய சிகிச்சைக்கட்டுகளை பார்வையிட உரிமை உண்டு. என்னுடைய தகவல்களின் அடையளம் இரகசியமாக வைக்கப்படும் என்பதை அறிவேன்.

இந்த ஆராய்ச்சியில் பங்கேற்க தன்னிச்சையாக முழு மனதுடன் சம்மதிக்கிறேன்.

பங்கேற்பாளரின் கையொப்பம்/ ரேகை
பங்கேற்பவர் பெயர்
இடம்:
தேதி:

ஆய்வாளர் கையொப்பம்
ஆய்வாளர் பெயர்
இடம்:
தேதி:

ஆராய்ச்சி தகவல் தாள்

ஆராய்ச்சி தலைப்பு

"ஆர்கனோ பாஸ்பரஸ் நச்சுத்தன்மையின் விளைவுகளை
முன்னறிவிப்பதில் தமணி இரத்தப் பகுப்பாய்வு"

ஆய்வாளர் பெயர் : மரு சௌ.முகில்

ஆய்வு நிலையம் : பொது மருத்துவப் பிரிவு
சென்னை மருத்துவக் கல்லூரி, சென்னை-3.

இந்த ஆய்வில் தங்களை பங்கேற்க அழைக்கிறோம். இந்த தகவல் அறிக்கையில் கூறப்பட்டிருக்கும் தகவல்கள் தாங்கள் இந்த ஆராய்ச்சியில் பங்கேற்கலாமா வேண்டாமா என்பதை முடிவு செய்ய உதவியாக இருக்கும். இந்த படிவத்தில் உள்ள தகவல்கள் பற்றி உள்ள சந்தேகங்களை நீங்கள் தயங்காமல் கேட்கலாம்.

இது ஆர்கனோ பாஸ்பரஸ் நச்சுத்தன்மையின் விளைவுகளை முன்னறிவிப்பதில் தமனி இரத்தப் பகுப்பாய்வு. அதற்கு இரத்தப்பரிசோதனை அவசியம். அதற்கு தங்கள் ஒத்துழைப்பு தேவை.

நீங்கள் இந்த ஆராய்ச்சியில் பங்கேற்க நாங்கள் விரும்புகிறோம். முடிவுகளை அல்லது கருத்துக்களை வெளியிடும்போதோ அல்லது ஆராய்ச்சியின்போதோ தங்களது பெயரையோ அல்லது அடையாளங்களையோ வெளியிடமாட்டோம் என்பதையும் தெரிவித்துக்கொள்கிறோம்.

இந்த ஆராய்ச்சியில் பங்கேற்பது தங்களுடைய விருப்பத்தின் பேரில்தான் இருக்கிறது. மேலும் நீங்கள் எந்த நேரமும் இந்த ஆராய்ச்சியில் இருந்து பின் வாங்கலாம் என்பதையும் தெரிவித்துக்கொள்கிறோம்.

இந்த சிறப்பு பரிசோதனையின் முடிவுகளை ஆராய்ச்சியின்போது அல்லது ஆராய்ச்சியின் முடிவில் தங்களுக்கு அறிவிப்போம் என்பதையும் தெரிவித்துக்கொள்கிறோம்.

ஆராய்ச்சியாளர் கையொப்பம்

தேதி:

பங்கேற்பாளர் கையொப்பம்
இடது கட்டைவிரல் ரேகை

தேதி :

INSTITUTIONAL ETHICS COMMITTEE
MADRAS MEDICAL COLLEGE, CHENNAI 600 003

EC Reg.No.ECR/270/Inst./TN/2013
Telephone No.044 25305301
Fax: 011 25363970

CERTIFICATE OF APPROVAL

To

Dr. Mukil. S,
PG in MD General Medicine,
Institute of Internal Medicine,
Madras Medical College
Chennai 600 003

Dear Dr. Mukil. S,

The Institutional Ethics Committee has considered your request and approved your study titled **"A CORRELATION OF ARTERIAL BLOOD GAS ANALYSIS IN PREDICTING OUTCOME OF ACUTE ORGANOPHOSPHORUS COMPOUND POISONING" NO.25082017.**

The following members of Ethics Committee were present in the meeting hold on **01.08.2017** conducted at Madras Medical College, Chennai 3

1. Prof.Dr.C.Rajendran, MD.,	:Chairperson
2. Prof.R.Narayana Babu,MD.,DCH., MMC,Ch-3	: Deputy Chairperson
3. Prof.Sudha Seshayyan,MD., Vice Principal,MMC,Ch-3	:Member Secretary
4. Prof. Gopalakrishnan,MD., Director,Inst.of Nephrology, MMC	: Member
5. Prof.S.Mayilvahanan,MD,Director,Inst. of Int.Med,MMC, Ch-3	: Member
6. Prof.A.Pandiya Raj,Director, Inst. of Gen.Surgery,MMC	: Member
7. Prof. Shanthy Gunasingh, Director Inst. of Social Obst. KGH	: Member
8. Prof.Rema Chandramohan,Prof.of Paediatrics,ICH,Chennai	: Member
9. Prof. Susila, Director, Inst. of Pharmacology,MMC,Ch-3	: Member
10.Prof. K. Ramadevi, MD., Director Inst. of Biochem, MMC,Ch	: Member
11.Prof. Bharathi Vidya Jayanthi,Director Inst. of Path, MMC	: Member
12.Thiru S.Govindasamy, BA.,BL,High Court,Chennai	: Lawyer
13.Tmt.Arnold Saulina, MA.,MSW.,	:Social Scientist
14.Tmt.J.Rajalakshmi, JAO,MMC, Ch-3	: Lay Person

We approve the proposal to be conducted in its presented form.

The Institutional Ethics Committee expects to be informed about the progress of the study and SAE occurring in the course of the study, any changes in the protocol and patients information/informed consent and asks to be provided a copy of the final report.

Member Secretary, Ethics Committee

MEMBER SECRETARY
INSTITUTIONAL ETHICS COMMITTEE
MADRAS MEDICAL COLLEGE
CHENNAI-600 003

S.No	Age	sex	occupation	compound	quantity	duration of symptoms (hrs)	POP Score D1	POP Score D2	POP Score D3	POP Score on Discharge	AchE D1 (U/L)	AchE D2(U/L)	AchE D3	AchE Discharge/Death(U/L)	ABG D1 PH	HCO3-(mmol/L)	PaCo2(mmHg)	ABG D2 PH	HCO3-(mmol/L)	PaCo2(mmHg)	ABG D3 PH	HCO3-(mmol/L)	PaCo2(mmHg)	ABG on Death/Discharge PH	HCO3-(mmol/L)	PaCo2(mmHg)	ABG Interpretaion	Atropine Dose	Intermediate syndrome	Ventilator	Duration of ventilation(Days)	Complications	Hospital Stay(Days)	Outcome
1	50	M	Non-Agri	Chlorpyrifos	150	6	Severe	Severe	Moderate	Mild	548	1535	3455	3788	7.47	26	30	7.43	24	40	7.4	24	40	7.36	24	38	RESPIRATORY ALKALOSIS	5	NO	YES	2	YES	5	Discharge
2	41	M	Agri	Monocrotphos	60	3	Moderate	Mild	Mild	Mild	2585	2585	2589	4532	7.35	22	39	7.35	22	40	7.35	23	42	7.36	24	42	NORMAL	6	NO	NO	0	NO	4	Discharge
3	43	M	Agri	Endosulphan	120	4	Severe	Severe	Severe	Severe	254	342	332	217	7.28	24	60	7.36	26	42	7.34	28	58	7.35	28	58	RESPIRATORY ACIDOSIS	22	NO	YES	5	YES	5	Death
4	25	M	Non-Agri	Parathion	80	3	Severe	Severe	Moderate	Mild	185	1490	2455	2788	7.49	24	28	7.48	22	30	7.46	20	34	7.44	20	36	RESPIRATORY ALKALOSIS	20	YES	YES	10	YES	15	Discharge
5	30	M	Non-Agri	Monocrotphos	50	8	Severe	Severe	Severe	Severe	190	455	533	585	7.29	20	62	7.31	22	55	7.33	24	50	7.34	28	48	RESPIRATORY ACIDOSIS	16	NO	YES	11	YES	11	Death
6	21	M	Non-Agri	Monocrotphos	80	6	Severe	Severe	Severe	Severe	245	546	566	568	7.47	24	28	7.46	24	32	7.47	22	30	7.46	24	28	RESPIRATORY ALKALOSIS	18	NO	YES	4	YES	7	Death
7	28	M	Non-Agri	Temephos	50	3	Mild	Mild	Mild	Mild	5666	5112	5223	5444	7.41	25	39	7.4	24	40	7.4	25	42	7.4	25	42	NORMAL	3	NO	NO	0	NO	3	DIscharge
8	35	F	Non-Agri	Chlorpyrifos	90	2	Severe	Severe	Severe	Severe	2554	3448	3223	2114	7.48	22	26	7.46	22	32	7.47	24	33	7.47	26	35	RESPIRATORY ALKALOSIS	16	NO	YES	5	YES	6	Death
9	18	M	Non-Agri	Chlorpyrifos	15	16	Moderate	Mild	Mild	Mild	3455	468		4577	7.42	25	40	7.42	25	40				7.42	25	40	NORMAL	2	NO	NO	0	NO	2	Discharge
10	75	M	Agri	Demeton	150	8	Severe	Severe		Severe	398	458		286	7.29	24	102	7.3	38	74				7.3	38	74	RESPIRATORY ACIDOSIS	18	NO	YES	2	NO	2	Death
11	30	M	Non-Agri	Monocrotphos	100	4	Severe	Severe	Severe	Severe	558	446	345	358	7.47	20	28	7.47	24	30	7.47	22	32	7.46	20	34	RESPIRATORY ALKALOSIS	28	NO	YES	5	NO	7	Death
12	27	M	Non-Agri	Malathion	50	14	Moderate	Mild	Mild	Mild	3557	4557	5343	5444	7.28	17	35	7.32	22	32	7.35	23	34	7.36	24	36	METABOLIC ACIDOSIS	6	NO	NO	0	NO	5	Discharge
13	35	M	Non-Agri	Isofluorphate	80	7	Severe	Severe	Severe	Severe	678	626	556	546	7.48	24	28	7.47	18	30	7.46	22	32	7.43	23	36	RESPIRATORY ALKALOSIS	26	NO	YES	5	YES	9	Death
14	24	F	Non-Agri	Bromophos	60	10	Mild	Mild	Mild	Mild	4566	4568	4578	4558	7.48	34	40	7.47	32	40	7.45	30	38	7.44	26	36	METABOLIC ALKALOSIS	6	NO	NO	0	NO	4	Discharge
15	37	M	Non-Agri	Diazinon	30	8	Moderate	Mild	Mild	Mild	4556	4556	5667	5668	7.32	18	32	7.34	20	335	7.35	22	36	7.36	22	37	RESPIRATORY ACIDOSIS	8	NO	NO	0	NO	5	Discharge
16	30	M	Non-Agri	Endosulphan	150	12	Severe			Severe	350			350	7.53	20	112							7.53	20	112	RESPIRATORY ALKALOSIS	20	NO	YES	1	YES	1	Death
17	45	M	Agri	Phorate	30	4	Moderate	Moderate	Mild	Mild	**843**	**950**	1224	4065	7.47	28	44	7.46	26	40	7.45	26	40	7.45	26	40	METABOLIC ALKALOSIS	6	No	No	0	No	7	Discharge
18	25	F	Non-Agri	Monocrotphos	150	16	Severe			Severe	158			158	7.52	26	108							7.52	26	108	RESPIRATORY ALKALOSIS	20	No	Yes	1	Yes	1	Death
19	48	M	Agri	Malathion	15	3	Mild	Mild	Mild	Mild	4536	5420	6228	6228	7.34	20	36	7.36	22	37	7.36	22	37	7.36	22	37	METABOLIC ACIDOSIS	3	No	No	0	No	3	Discharge
20	35	M	Non-Agri	Temephos	20	4	Mild	Mild		Mild	5684	6632		6632	7.4	23	38	7.4	24	40				7.4	24	40	NORMAL	2	No	No	0	No	2	Discharge
21	21	F	Non-Agri	Profenofos	100	8	Severe	Severe	Severe	Severe	**224**	**180**	324	**2335**	**7.28**	**28**	**115**	**7.3**	**32**	**69**	**7.32**	**36**	**58**	**7.33**	**24**	**55**	RESPIRATORY ACIDOSIS	32	Yes	Yes	9	Yes	15	Death

22	28	M	Non-Agri	Monocrotphos	100	7	Severe	Severe	Severe	Severe	**368**	**254**	324	**3454**	**7.52**	**22**	**21**	**7.49**	**18**	**29**	**7.47**	**20**	**35**	**7.46**	**20**	**35**	RESPIRATORY ALKALOSIS	24	Yes	Yes	3	Yes	7	Death
23	48	M	Agri	Primiphos	50	2	Moderate	Mild		Mild	**2987**	**3336**		4853	7.43	26	40	7.44	25	41				7.44	25	41	NORMAL	4	No	No	0	No	2	Discharge
24	70	M	Agri	Chlorpyrifos	150	6	Severe			Severe	**358**			358	7.49	22	41							7.49	22	28	RESPIRATORY ALKALOSIS	16	No	Yes	1	Yes	1	Death
25	21	F	Non-Agri	Endosulphan	25	2	Mild	Mild	Mild	Mild	**3647**	4688	5536	5536	7.45	25	39	7.44	24	38	7.43	23	38	7.43	23	38	NORMAL	3	No	No	0	No	3	Discharge
26	38	F	Non-Agri	Dimethoate	30	3	Mild	Mild	Mild	Mild	5985	**3882**	5221	5232	7.33	20	35	7.35	22	37	7.37	24	39	7.37	24	39	METABOLIC ACIDOSIS	3	No	No	0	No	4	Discharge
27	38	M	Non-Agri	Triazophos	25	2	Moderate	Moderate	Mild	Mild	4165	**3662**	5688	6345	7.49	30	43	7.47	28	45	7.44	25	40	7.43	24	39	METABOLIC ALKALOSIS	5	No	No	0	No	6	Discharge
28	50	M	Agri	Diazinon	100	6	Severe	Severe	Severe	Severe	**287**	**195**	346	**366**	**7.49**	**26**	**31**	**7.49**	**26**	**31**	**7.47**	**25**	**32**	**7.47**	**27**	**35**	RESPIRATORY ALKALOSIS	**18**	Yes	Yes	**2**	Yes	5	Death
29	41	M	Non-Agri	Quinalphos	25	3	Mild	Mild	Mild	Mild	**7835**	**7235**	7647	7647	7.38	22	37	7.39	23	40				7.39	23	40	NORMAL	3	No	No	0	No	2	Discharge
30	29	F	Non-Agri	Chlorpyrifos	15	1	Mild	Mild	Mild	Mild	5432	5910	6341	6341	7.44	26	45	7.44	25	42	7.43	26	42	7.43	26	42	NORMAL	3	No	No	0	No	3	Discharge
31	20	M	Non-Agri	Monocrotphos	150	5	Severe	Severe	Severe	Severe	**389**	**165**	1242	**1563**	**7.52**	**25**	**30**	**7.49**	**28**	**36**	**7.47**	**26**	**38**	**7.33**	**18**	**40**	RESPIRATORY ALKALOSIS	**26**	Yes	Yes	**2**	Yes	6	Death
32	60	F	Agri	Dicrotophos	75	8	Moderate	Moderate	Moderate	Mild	**2180**	**1672**	2656	5839	7.29	15	40	7.31	18	35	7.33	20	39	7.38	24	38	RESPIRATORY ACIDOSIS	52	Yes	Yes	14	Yes	20	Discharge
33	37	F	Non-Agri	Monocrotphos	100	3	Severe	Severe	Severe	Severe	**1894**	**759**	560	**580**	**7.51**	**20**	**28**	**7.5**	**20**	**30**	**7.49**	**18**	**32**	**7.49**	**18**	**32**	RESPIRATORY ALKALOSIS	**25**	No	Yes	**3**	Yes	3	Death
34	34	F	Non-Agri	Diazinon	50	5	Moderate	Mild	Mild	Mild	4376	**3852**	5645	6479	7.29	18	71	7.31	24	58	7.33	22	48	7.37	24	38	RESPIRATORY ACIDOSIS	14	Yes	Yes	4	No	8	Discharge
35	26	F	Non-Agri	Phorate	100	5	Severe	Severe	Severe	Severe	**687**	**416**	1558	**1853**	7.53	21	27	7.49	20	29	7.47	18	32	7.38	23	38	RESPIRATORY ALKALOSIS	**18**	Yes	Yes	**3**	Yes	7	Death
36	35	M	Agri	Diazinon	25	2	Mild	Mild	Mild	Mild	4751	**3674**	6790	6790	7.52	30	45	7.49	28	45	7.38	25	38	7.38	25	38	METABOLIC ALKALOSIS	2	No	No	0	No	3	Discharge
37	18	M	Non-Agri	Ethion	30	2	Moderate	Mild	Mild	Mild	4569	**3357**	4798	4798	7.51	32	44	7.48	28	43	7.45	26	41	7.45	26	41	METABOLIC ALKALOSIS	**4**	No	No	**0**	No	3	Discharge
38	60	M	Agri	Quinalphos	50	5	Moderate	Moderate	Mild	Mild	**2705**	**942**	3456	4521	7.46	20	34	7.44	22	37	7.44	22	37	7.44	22	37	RESPIRATORY ALKALOSIS	6	No	No	0	No	5	Discharge
39	58	M	Non-Agri	Phosphomidon	75	4	Severe	Severe	Severe	Severe	**586**	**295**	1458	**2628**	**7.55**	**21**	**30**	**7.54**	**18**	**30**	**7.42**	**18**	**31**	**7.51**	**18**	**28**	RESPIRATORY ALKALOSIS	**10**	Yes	Yes	**2**	Yes	6	Death
40	22	F	Non-Agri	Phosphomidon	100	3	Severe	Severe	Severe	Mild	**369**	**158**	348	4984	7.29	25	91	7.33	29	56	7.34	31	54	7.41	27	46	RESPIRATORY ACIDOSIS	**42**	Yes	Yes	**18**	Yes	26	Discharge
41	70	F	Agri	Fenthion	25	2	Mild	Mild		Mild	**1586**	**995**		**2864**	**7.44**	**26**	**41**	**7.44**	**26**	**41**				7.44	26	41	NORMAL	**12**	No	Yes	**2**	Yes	2	Discharge
42	30	M	Non-Agri	Dimethoate	75	5	Severe	Severe	Moderate	Mild	**964**	**391**	1248	4835	7.31	24	88	7.33	28	58	7.39	30	48	7.4	26	41	RESPIRATORY ACIDOSIS	**34**	Yes	Yes	**9**	Yes	14	Discharge
43	14	M	Non-Agri	Phorate	50	4	Moderate	Moderate	Mild	Mild	**751**	**258**	1548	**3513**	**7.47**	**22**	**33**	**7.47**	**18**	**37**	**7.43**	**20**	**38**	**7.4**	**21**	**36**	RESPIRATORY ALKALOSIS	**4**	No	No	**0**	No	5	Discharge
44	50	M	Agri	Monocrotphos	150	10	Severe	Severe	Severe	Severe	**239**	**176**	248	**898**	**7.52**	**22**	**31**	**7.55**	**28**	**32**	**7.53**	**22**	**30**	**7.53**	**22**	**30**	RESPIRATORY ALKALOSIS	**25**	No	Yes	**3**	Yes	3	Death
45	38	M	Non-Agri	Dichlorphos	30	2	Mild	Mild	Mild	Mild	**3584**	**3395**	4216	**4216**	**7.38**	**22**	**37**	**7.38**	**23**	**39**	**7.39**	**24**	**41**	**7.39**	**24**	**41**	NORMAL	**4**	No	No	**0**	No	3	Discharge

46	17	M	Non-Agri	Malathion	25	3	Mild	Mild	Mild	Mild	**2230**	**1675**	3445	**4105**	**7.33**	**23**	**62**	**7.35**	**27**	**48**	**7.37**	**26**	**44**	**7.38**	**25**	**42**	RESPIRATORY ACIDOSIS	**12**	No	Yes	**2**	Yes	5	Discharge
47	30	M	Non-Agri	Monocrotphos	150	4	Severe			Severe	**364**			**364**	7.57	25	28							7.57	25	28	RESPIRATORY ALKALOSIS	**20**	No	Yes	1	Yes	1	Death
48	42	M	Agri	Ethion	30	3	Moderate	Moderate	Mild	Mild	4130	**3358**	5882	5891	7.48	22	30	7.46	22	34	7.44	25	39	7.44	25	39	RESPIRATORY ALKALOSIS	**6**	No	No	**0**	No	4	Discharge
49	22	M	Non-Agri	Triazophos	25	2	Mild	Mild	Mild	Mild	**3156**	4239	5510	5510	7.46	24	34	7.44	23	38	7.4	25	40	7.4	25	40	RESPIRATORY ALKALOSIS	**3**	No	No	**0**	No	3	Discharge
50	20	F	Non-Agri	Chlorpyrifos	100	22	Severe	Severe	Severe	Severe	**566**	**391**	582	**1753**	**7.28**	**22**	**47**	**7.31**	**26**	**47**	**7.33**	**26**	**45**	**7.32**	**26**	**54**	RESPIRATORY ACIDOSIS	**22**	No	Yes	**4**	Yes	4	Death